The Welding Engineer

Reg. U. S. Pat. Office

Founded by L. B. Mackenzie, 1916

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OCTOBER, 1931 | VOL. 16, NO. 10

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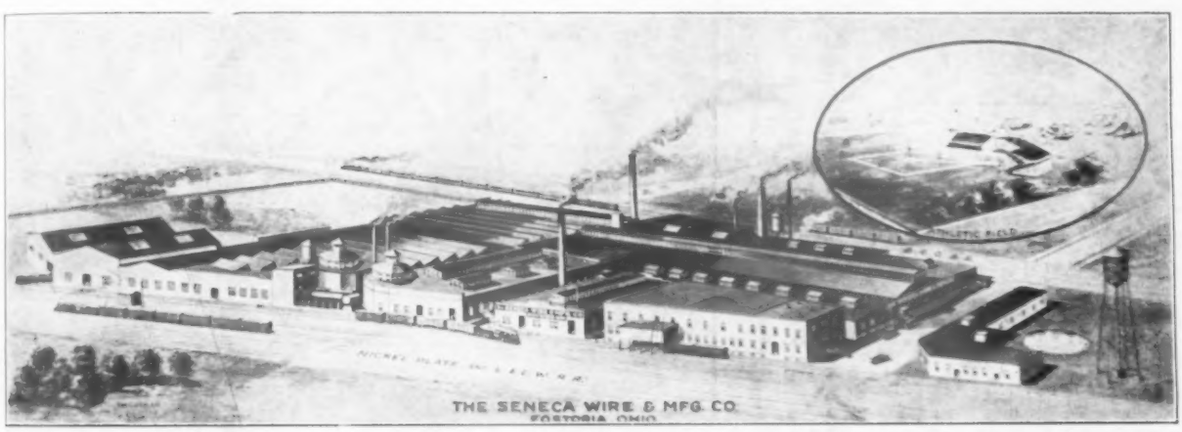

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The Welding Engineer

Founded by L. B. Mackenzie, 1916

October, 1931

with which is combined Acetylene Journal

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H. S. Card.....Secretary

H. S. Card.....Editor
M. S. Hendricks.....Managing Editor

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The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

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ABP

LEGISLATION IS NOT A CURE

THAT reforms are difficult to realize when left to the compulsion of law and administration is one of the blunt statements contained in a booklet entitled "What's Ahead?" for the Steel Construction Industry, recently distributed by the American Institute of Steel Construction. It is further explained that no statute will ever cure business men of the evil of price cutting until business men cure themselves individually of all desire to indulge in evil practices. The Institute does not interest itself in any of the questions that relate to prices or to the restraint or control of competition, but it recognizes that the responsibility for the evils which result from profitless operation rests clearly upon individuals, and in its message to steel constructors a few words on this phase of the subject are certainly in order. The bulletin is certainly a splendid inspirational picture of the possible volume of business ahead of the steel industry. Here is an organization which visualizes a potential future market for 10 million tons of structural steel in undeveloped fields, but which recognizes at the same time that such fields cannot be cultivated properly without first destroying the illusion that greater profits can be obtained from an increase in volume secured by price cutting. The outlook is for greater quantities of steel to be used and consequently greater quantities of welding equipment and welding materials. It should be possible to realize profits on this new business, but this will be done only by those manufacturers who are profit conscious rather than volume conscious.

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

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EDITORIAL

A Century of Progress

VISITORS in Chicago these days are showing an increased interest in the steady progress which is being made in the construction of buildings for the World's Fair, which is to open in 1933. Quite frequently the question is raised as to whether it is going to be possible for the officials of the Fair to go ahead with their plans. The answer to this is that the entire plan was adequately financed two years ago and there is nothing to hinder a continuance of the construction program up to its opening on the scheduled date. In short, its success is assured in advance. This fact should be a source of encouragement to every business man in the country. A Century of Progress will naturally be a tremendous stimulant to local trade and industry in the Chicago district, but the general effect will be a great deal more important than that. The exhibitions will, through their sales value, create a big demand for products of practically all of the industries in the country, and this demand will come not only from the United States but from all of the countries in the world. It is inconceivable that any business depression can continue in the face of such a large scale commercial movement. There is a strong probability, however, that general business conditions will be on the up-grade by the time the Fair is open and that the event will act to hasten the recovery. Just how much this splendid exposition will do for the welding industry would seem to depend upon the industry itself. There is exhibition space available at a reasonable rate, so that the entire industry could be represented by a group exhibit. Ground space could also be made available to the industry for the construction of a special building if sufficient funds were available for this purpose. In other words, the opportunity for displaying the merits of the welding processes is unlimited. A large staff of men is now settled in the Administration Building and are actively engaged in cooperating with individual firms and groups in the preparation of exhibits of all sizes, ranging from 200 square feet of inside space to acres of ground space. Several large laboratories are busy with the development of new methods of display and illumination. As a whole, the facilities for service to exhibitors are splendidly arranged. A good showing of the welding processes is therefore something which deserves the thoughtful consideration of all of the leaders of the welding industry.

The National Safety Congress

VERY few organizations have been able to show the marvelous growth which has been enjoyed by the National Safety Council. Old timers in the industry will recall that safety work was so scarce as to be considered almost a fad twenty years ago. The Twentieth Annual Safety Congress is being held in Chicago this month, anticipating an attendance of approximately 7,000 delegates. These delegates will represent all types of industry as well as many social, civic and educational agencies. They will come from all parts of the country and from many foreign nations. Papers to be read at the Congress will indicate clearly that safety work has become an item of major importance in all of our large industries. They have found that organized safety prevents injury and death wherever it can get a good foot-hold. In fact, accident fatalities have decreased 30% in the past twenty years and accident rates have been reduced 28% in two years by 1600 industrial establishments reporting to the National Safety Council. This body recognizes that the problems which face the organized safety movement during the next two decades are as great as those which faced the pioneers in this movement twenty years ago. The National Safety Congress will be the means of producing quantities of new evidence proving that organized safety work is profitable. It is, however, up to the individual plant executives to enforce safety regulations, so that this splendid effort may bear the greatest fruit.

New Welding Wire Specifications

THE new draft of the welding wire specifications covering filler material for both gas and arc welding, which was discussed at the recent Fall Meeting of the American Welding Society, promises to be of tremendous interest when it is finally completed and approved. The purpose of the revised specifications is to get entirely away from the use of chemical analysis as a basis for the application of welding wire. It is proposed to divide filler materials into various classes ranging from those to be used on Class I pressure vessels down to those used ordinarily on jobs where ductility and fatigue stresses are not very important considerations. The basis for classification in each case will be the physical properties of the deposited metal. In other words, the new specifications will emphasize performance instead of composition. With such a specification, it is apparent that bare wire would be classified the same as coated wire, provided that they are capable of producing the same net results. Undoubtedly this radical change in welding wire specifications will be burdensome in the beginning for some of the manufacturers but it is felt by a great many of those in the industry that in the long run the results will be beneficial to all concerned. At any rate there is sufficient promise of improvement to warrant the exercising of considerable patience in meeting the new situations which will arise when the change is put into effect.

Boston Makes Good

REPORTS received at headquarters of the American Society for Steel Treating have indicated that not only did the exhibitors at the National Metal Congress and Exposition make a splendid, attractive showing but that the registration and attendance were quite remarkable considering the conditions. With respect to the latter item, it is noted that the fine registration of members of the co-operating societies totaled 4,149 and the total attendance at the exposition was over 51,000. As for the Fall Meeting of the American Welding Society, those in charge of registration reported before the meeting was over that the volume of registrations at the Copley-Plaza had exceeded that of all previous years; and as for the exposition, even though it did not at any time seem to be over crowded the fact that the location was considerably removed from the business and shopping district would tend to indicate that there was a genuine interest on the part of those who did attend it. The welding industry is, in fact, to be congratulated on being able to make so good a showing in the midst of such discouraging business conditions as existed around the middle of September. At the same time, the Boston district is to be complimented on its splendid turnout. Those who arranged the program and entertainment features certainly gave visitors their money's worth.

The New REGO Cutting Torch

lighter . . . . . stronger cuts faster . . . . . uses less fuel gas and oxygen

See the new Rego CC Torch and other Rego products at the National Metal Congress, Boston, Sept. 21 to 25, inclusive.

It's the lightest weight heavy duty cutting torch ever produced, this REGO CC Torch. Seamless Monel metal tubes and Monel head make it as tough as it is light. Smaller head makes it handier to use . . . interchangeable head angles widen its range of usefulness . . . high pressure valve outside the handle facilitates repairs and readjustments . . . taper seated joint in head makes it easier to change tips and avoids leakage at the tip.

But after all it's the tip and the improved method of gas mixing that make the new REGO Cutting Torch really different and better. In other words, Performance. This torch is, by actual comparison, one third faster and it uses one fifth less fuel gas and oxygen. That's economy two ways.

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New Rego Cutting Torch with 3 tips . . . choice of 90°, 75°, 35° or straight head assembly . . . choice of side or bottom lever. Price only

$42.00

(Bottom Lever will be furnished unless otherwise specified.)

The BASTIAN BLESSING CO., 246 E. Ontario St. CHICAGO, ILL.

The Quality of Weld Metal*

Factors Affecting the Quality of the Weld—What the Mechanical and Chemical Qualities Are—Effect of Atmospheric Contamination

By J. C. Hodget

WELDING has been defined as the uniting or consolidating of two pieces of metal, this being accomplished by the application of either heat or pressure or a combination of the two. Recent years have seen the development of Thermit welding, gas welding, metal and carbon arc welding, and electric resistance welding, with their various sub-divisions, all processes dependent upon the production of localized high temperatures far in excess of the melting temperature of the base metals to be welded.

It is not the purpose of this paper to describe the various welding processes. A complete classification of the welding processes and a brief description of each welding process, has been excellently outlined by Mr. F. T. Llewellyn in his paper "General Survey of Welding Processes," presented before the March, 1931, Symposium on welding sponsored by the American Society for Testing Materials.

While the fundamental properties governing the quality of welded joints are the same regardless of the welding process used, this paper is limited to specific examples of the metal arc welding process. The metal arc welding process may be immediately placed as one of the most important of the fusion welding processes, this by reason of its present wide application and its very much greater potential application in engineering structures.

We may take for example the application of welded construction to the joining of the component parts of pressure vessels. The service conditions of pressure vessels for steam generation, of pressure vessels for the oil industry, and of pressure vessels for the chemical process industries, are particularly severe. Temperatures of 900 to 1100°F and pressures of 1000 to 1600 lbs. per sq. in. and even higher are not uncommon. Changes of pressure and of temperature during the life of the pressure vessel produce cycles of stress within the structure, and chemical conditions within the pressure vessel further complicate the problem by introducing the varying element of corrosion. Fusion welded joints as main members of a structure with an efficiency of 100 per cent, will be called upon to withstand the same conditions as the parent or base metal of the structure.

A little consideration of the above brief statement of operating conditions in one type of welded product immediately points to the importance of a complete understanding of the mechanical, physical and physico-chemical properties of the welded joints, in other words an understanding of the quality of the welded joints. This involves an extensive study of the fundamental or primary properties of welded joints such as the chemistry, metallography and x-ray crystallography of the welded joint.

If we take any one of the various welding processes we find that the process requires the control of a large number of variable conditions attendant to the process. For metal arc welded joints we find that the various factors affecting their properties or their quality, may be classified into seven major groups, as follows:

(1) The parent or base metal.

(2) The electrode or welding wire.

(3) The chemistry and physics of the metal arc.

(4) The chemistry and physics of the molten metal after deposition.

(5) The cooling from solids to a minimum temperature and cycles of re-heating due to subsequent welding.

(6) Treatment of the welded joint after deposition.

(7) Design of welded joints.

Each of the above major groups represents a large number of variables, and a satisfactory discussion of all the variables involved in a welding process, would require an extremely long time. Many of these variables are dependent upon each other. A satisfactory understanding of many of these variables has not as yet been reached. Many of them are of minor importance while a few of them overshadow all others in their effect upon the quality of the deposited metal.

The effect of the atmosphere surrounding the metal arc, which variable would fall in Group No. 3 of the above classification, is I believe, of paramount importance. At the temperature of the metal arc, both the nitrogen and oxygen of the atmosphere are extremely active chemically and readily combine with most of the elements of all electrodes. Oxidation of manganese, silicon, carbon and iron readily takes place in the plain low carbon steels and iron, and possibly manganese nitrides are also formed. Where the electrode contains elements with high affinities for oxygen such as vanadium, chromium, aluminum, etc., oxidation of these elements will progress rapidly. The resultant metal is therefore quite brittle unless suitable means are taken to—

(1) Protect the molten metal by using a covered electrode or by bathing the arc with a less active gas than the normal atmosphere such as hydrogen.

Due to the large number of variables mentioned above, it is readily evident that welding by any process may result in welds with varying degrees of excellence of their properties, depending upon the numerous other variables. For some engineering structures where the welded joints are subject to relatively low static stress, a welded joint of mediocre quality will be satisfactory, being amply protected by a large factor of safety. Where however, the welded joints are given an efficiency of 100%, it should be expected that the properties of the joint be at least equal to that of the base metal, particularly with regard to those properties which are of importance in the service of the structure.

The various properties deciding the quality of weld metal for the service conditions involved are as follows:

I Mechanical Properties at a range of temperatures
- Ultimate strength
- Elastic limit or yield point
- Elongation
- Reduction of area
- Impact strength
- Hardness
- Bend tests
- Endurance or fatigue limit

II Chemical Properties
- Resistance to corrosion
- Embrittlement under various conditions.

All of the above specific properties for weld metal suitable

*Paper presented at Welding Symposium, Lehigh University, March 27, 1931.

†Babcock & Wilcox Co., Barberton, Ohio.

for welding the low carbon structural steels, have not been determined; at least complete quantitative data has not as yet been published. These specific properties are dependent upon the following primary properties of weld metal:

I Chemistry—of the weld metal,

II Radiography—of the fusion zone,

III X-Ray Crystallography—of the affected zone, and

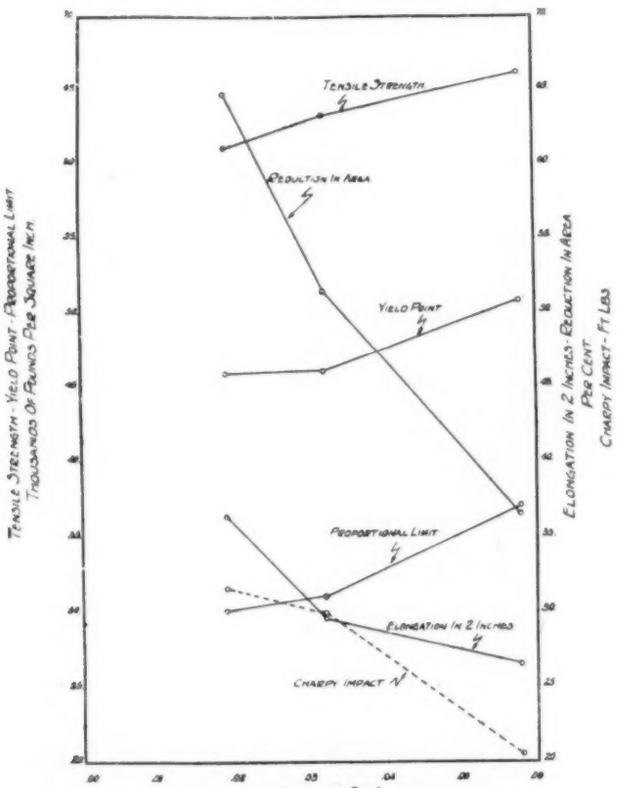
IV Metallography—of the parent metal.

(a) Metallographic constituents and their distribution, grain size and shape of grain.

(1) Normal constituents

(2) Impurities
- Nitrides
- Oxides
- Silicates

(b) Macroscopic Characteristics:
- Cracks
- Laps
- Incomplete fusion
- Blowholes and porosity
- Large slag inclusions


Tensile Strength
Reduction in Area
Yield Point
Proportional Limit
Elongation in 2 Inches
Charpy Impact
Tensile Strength - Yield Point - Proportional Limit Thousands of Pounds Per Square Inch
Elongation in 2 Inches - Reduction in Area Per Cent. Charpy Impact - Ft Lbs
Nitrogen - Per Cent.

The Relation Between Nitrogen Content And Physical Properties Obtained On .505 Inch Dia. x 2 Inch Ga. Length All Weld Metal Tension Test Specimens. Barberton Weld. Strain Relieved At 1200°F

Figure 1.

Data on some of the above properties has been presented in two previously published papers by the author*. This data is summarized in the following tables, two types of metal arc weld metal being compared with low carbon structural steel (A. S. M. E. firebox plate). One type of weld metal is typical of that deposited from bare or ordinary electrodes, which does not give any protection to the molten metal being deposited from the active constituents of the atmosphere. The second type of weld metal represents the highest quality of weld metal which has been developed to date. This second type of weld metal is fully equal to the plate or base material in all of its properties, and it is entirely safe for welded structures where the operating conditions impose severe stresses on the welded joints such as welded pressure vessels of the type referred to earlier in the paper.

*Application of Fusion Welding to Boiler Drums, fall meeting of American Welding Society, September, 1930. Journal American Welding Society, October, 1930.

*A General Specification for Welded Pressure Vessels, Western Metal Congress, San Francisco, February, 1931. Journal American Welding Society, April, 1930.

TENSILE PROPERTIES

Transverse Specimens

	A. S. M. E. fire-box plate	First Quality Weld Metal	Ordinary or bare electrode weld metal
Ultimate Strength, lbs., sq. in.			
Min.	55,000	65,000	
Max.	65,000	74,500	56,000
Ave.		67,500	50,000
Yield Point, lbs., sq. in.			
Min.	½	47,000	
Max.	Ult.	58,900	50,000
Ave.	Str.	51,000	42,000

All Weld Metal Specimens

	A. S. M. E. fire-box plate	First Quality Weld Metal	Ordinary or bare electrode weld metal
Yield Points, lbs., sq. in.			
Min.	Not	40,000	35,000
Max.	Spec.	65,000	50,000
Ave.		52,000	42,000
Ultimate Strength, lbs., sq. in.			
Min.	Not	60,000	40,000
Max.	Spec.	72,000	63,000
Ave.		67,000	52,000
Elongation in 2 in.			
Min.	Not	20.5	5.0
Max.	Spec.	38.0	18.0
Ave.		28.0	8.0
Reduction of Area			
Min.	Not	32.0	10.0
Max.	Spec.	65.0	25.0
Ave.		40.0	15.0
Bend Tests			
Elong. of the outside fiibres	50%	50%	10-20%
Angle of Bend	180°	180°	10-20°
Impact Tests			
Min.	19 ft.-lbs.	20 ft.-lbs.	1 ft.-lbs.
Max.	33 "	45 "	8 "
Ave.	20 "	28 "	5 "
Endurance Limit			Less than
Lbs. sq. in.	28,000	30,000	15,000
Specific Gravity			
Min.		7.80	7.44
Max.		7.85	7.68
Ave.	7.84	7.83	7.59
Chemical Analysis			
Sulphur	Less than 0.04	Less than 0.045	Less than 0.045
Phosphorus	" " 0.04	" " 0.040	" " 0.040
Manganese	0.30 to 0.60	0.30 to 0.60	" " 0.20
Carbon	Not over 0.30%	0.08 to 0.15	0.02 to 0.08
Nitrogen as iron	Not spec.	Less than 0.02	0.10 to 0.14
Nitride	Will not usually be over 0.009		

The present paper presents for the first time data on:

(1) The effect of nitrogen on the physical properties of weld metal.

(2) The impact energy-temperature relationship for the two types of weld metals.

Effect of Nitrogen

To determine the effect of different degrees of protection from atmospheric contamination, all other factors being held constant, upon the properties of weld metal, three welds were made, the atmospheric conditions surrounding the arcs were so regulated as to produce weld metals with nitrogen contents of 0.058%, 0.032% and 0.019%. Tensile and impact specimens were obtained from the three welds. The relationship existing between the physical properties and the nitrogen contents of the three welds is shown diagrammatically in Figure 1.

These results show that, all other factors remaining the same, increasing nitrogen content (or increasing atmospheric contamination), causes:

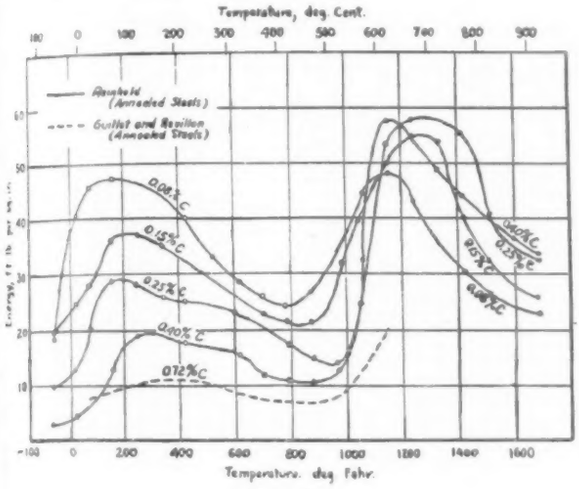


Figure 2.

Temperature Impact Tests

Figure 2 shows the impact energy-temperature curves of carbon steels presented by French and Tucker in their paper "Available Data on the Properties of Irons and Steels at Various Temperatures," May 29, 1924. The following is quoted from this paper:

> "The changes of the impact energy with temperature shown in the curves appear to be quite generally characteristic of the majority of steels for which data are available."

Inasmuch as weld metal is produced under special conditions with resultant composition structure and properties peculiar to those conditions, the impact values of weld metals at high temperatures can not be predicted based on the general form shown in Figure 2. Figure 3 shows diagramatically the impact energy-temperature relationships for the two types of welds, that is, the ordinary type of weld metal deposited from a bare electrode, and first quality weld metal deposited under conditions giving the maximum protection from the atmosphere.

The impact energy-temperature curves shown in Figure 3 are similar to the general form of the curves for the low carbon steels shown in Figure 2, the differences being of magnitude only. It should be again noted that the effect of atmospheric contamination or high nitrogen content has been to seriously reduce the resistance to impact of the weld metal throughout the entire temperature range. Our investigations on both of the above subjects are not as yet completed, and more data will be available within a short time.

Summary

This very brief paper on the quality of weld metal shows that of the various factors and variables, to which the metal arc welding process is subject, the degree of contamination of

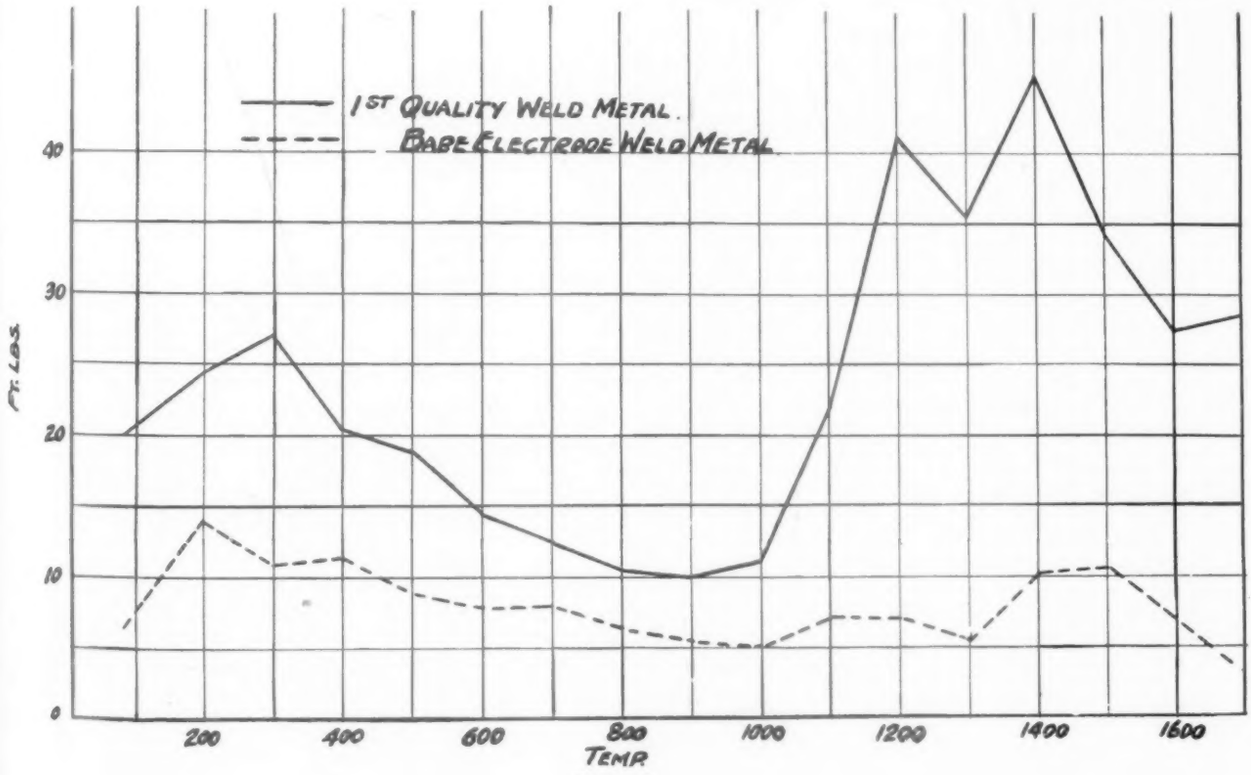


Figure 3.

(1) An increase in proportional limit, yield point and tensile strength of the weld metal.

(2) A decrease in the ductility criterions, per cent elongation and reduction of area of weld metal.

(3) A decrease in the resistance to impact of the weld metal.

the weld metal during its deposition by the constituents of the atmosphere is of very great importance.

Given a weld metal free from major defects, the quality of the metal as measured by its mechanical and physical properties is largely governed by the relative nitride and oxide contents.

Hard Facing in Tank Shop*

Using Dies Made of Plate Steel, Hard Surfaced, Saves Production Time and Reduces Cost of Dies in Many Cases

By Louis Perona†

HARD surfacing in the tank shop serves the double purpose of producing long wearing dies at low cost and of getting these dies made to order on short notice. A contributing factor to both of these results is the use of ordinary plate steel for the body of the die, this material being low in cost and easy to fabricate with the equipment found in any tank shop.

Fig. 1.

Fig. 2.

Fig. 3.

Our first experience was with an order of tanks that required a head 8 inches in diameter, 14 gauge, flanged and dished. The cost of buying these heads in the open market was prohibitive considering our allowance for production in this case. There were 1000 tanks ordered which meant 2000 heads. We decided to try making the necessary dies from steel plate covered with hard surfacing material instead of the too steel dies. We made both blanking and dishing dies. Figure 1 is a sample of the heads which we made. We have made possibly 10,000 heads from this set of dies without regrinding it.

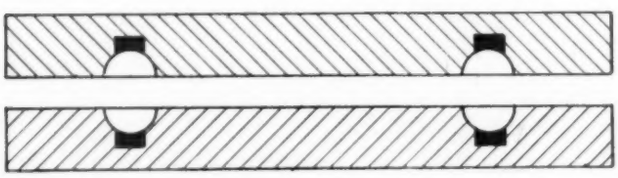


Fig. 4. Heavy Black Areas Show Where Stellite Was Applied.

Since that time we have made dies to make 10 inch, 12 inch and 13 inch heads from 16 gauge to 3/16-in. in thickness.

Later we were presented with the problem of making a new Hinge Type Fill Cap used on truck tanks (Fig. 2). These were to replace the old screw type style of fill cap. Again we used hard surfaced dies to make the sample shown. With the exception of the two forged lugs, the spring and malleable iron handle and arm, all the rest was made with hard surfaced dies.

At one time we had work that required a hole punched in ¼ inch plate, leaving a slug resembling a handhole plate 3 x 4, standard size. These we proceeded to turn out with our hard surfaced dies, giving us an interesting by-product. Our success with this welding method has resulted in securing occasional jobs from neighborhood concerns. For example, a jobbing firm in our town was asked to make a turntable operating on 1-inch chilled steel balls. They would push a heavy loaded car to this turntable and divert its direction wherever they wanted to go. But the common steel plate they used would not stand up. We grooved the lower and upper plates as shown in Figure 4, filled them up with Stellite and the owners put them back in service. That was a year or more ago and we have not had any complaint about them.

Another chemical firm in our town operated some kind of a crusher in which they had been using high carbon steel bars

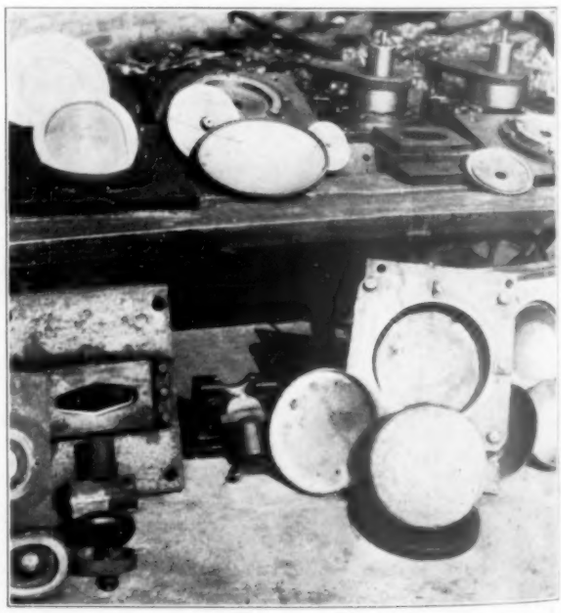


Fig. 5. A Few of the Dies Used by This Progressive Manufacturer of Tanks, Tank Wagon Assemblies, and Dump Truck Bodies. Dies and Punches Are Built Up of Steel Plates, Brass and Shapes with All Cutting Edges Faced with Haynes Stellite Grade 6 Applied with the Torch. Material Pinched and Formed Ranges from 18 to 10 Gauge.

*From a paper read before the American Welding Society, Chicago Section, Oct. 2, 1931.

†Welding Foreman, Farrel Mfg. Co., Joliet, Ill.

as fingers to crush some hard kind of material. It was very costly on account of the high price of this special steel, and they had to replace them often because when the edge wore off to about ⅛ inch diameter they had to be replaced. I took common steel shanks, grooved the wearing point, and while the hard surfacing material was hot, filed an edged that gave them something more like what they wanted. About six weeks after they were in service, I got an order to make them for all the other plants which they own throughout the country. To date, I have not heard of them having any trouble with these points.

About three weeks ago the superintendent of one of these plants came to see me. It was about 10:30 in the morning and he asked me to hard surface two manganese steel shoes that he had with him. When I finished them, he told me that he would bet me a box of cigars that the material I had used would be off by six o'clock that night. I told him I would not bet, because I didn't know what he was going to use them on. He then said that if they did last that long he would give me a box of cigars. I didn't hear from him again that day, but the next morning he was at the shop bright and early with a set of twelve shoes for me to hard surface. He told me the samples ran all night and showed no signs of wear. He also brought the box of cigars. A customer who acts like that nowadays is certainly a satisfied customer.

A 174-Hour Training Schedule

By H. P. Davidson†

TRAINING twelve youthful candidates to become qualified welders in approximately one hundred and seventy hours requires an unlimited amount of patience, a great deal of perseverance, and a psychological insight into the workings of each student's mind. He must be understood, he must be made to understand. His enthusiasm runs high and his interest grows deeper, as, with the constant aid and encouragement of his instructor, he rapidly conquers his ignorance, nervousness and backwardness or doubt of ability.

Confidence must be gradually built into the man. When the candidate becomes instilled with confidence, generally after three days of welding practice, with intermittent demonstrations and lectures, he is prepared to commence to learn Oxy-Acetylene welding in earnest.

The first instructions comprise a brief on the different kinds of metals, their re-action to the oxy-acetylene flame and their purpose, with particular emphasis on those employed in aircraft construction. Next they are lectured upon the set-up and care of their apparatus, every point in its care being stressed frequently throughout the entire period of instruction. Now follow two or three practical demonstrations by the instructor, until they have all agreed that they have gained sufficient knowledge of the equipment, its care and set-up. To make certain, each student stands by his outfit and is aided in setting up, lighting and producing a *neutral* flame. This is performed two or three times as a drill and each flame inspected for a neutral quality.

At no time must the student be left in doubt as to the correctness of the set-up, the quality of the flame, the proper position of the specimen to be welded, or the character of his weld. Incorrect methods and experiments cannot be tolerated, if the candidate is to accomplish what he has set out to do.

Their first application comes on the afternoon of the second day. Each student is given two pieces of ⅛ x 1 x 2¾ in. mild steel for his first coupon. The instructor starts with a demonstration, then progresses from one student to the other where he aids in the execution of the first weld, grasping the torch and rod near the student's hand, performing correct torch and rod manipulation, and explaining angle of torch, relative to work, distance of flame from puddle, direction of weld and the continuity necessary to build a bead. This first coupon is padded with a series of beads, going away from welder, then turned to complete the series. Each bead is wire-brushed thoroughly, inspected for traces of carbon or oxide, adhesions or surface flaws, improvement of ripple and tangent of bead.

The students must necessarily spend a good portion of their evenings poring over their text, *The Welding Encyclopedia*, comparing notes and lectures. Each morning they are subjected to a written examination of ten questions. Two daily progress marks are given, one on theory and one on practical work. These marks are averaged at the end of the weekly period, a passing mark of 75 being required.

The second week finds the students endeavoring to coordinate the fundamentals of precision and quality in welding. Penetration and fusion are to be accomplished, with particular regard for the latter on steel tubing, used in the construction of aircraft. At this period, vertical and overhead welding are introduced. Various thicknesses of mild steel coupons are welded throughout the six weeks period. Four hours a week are devoted to this practice, which also includes the different positions welded on steel tubing. Backward welding is an occasional practice exercise on thicker pieces of mild steel.

The second, third and fourth weeks are spent in cutting, fitting and welding every conceivable joint employed in the construction of an airplane, with the numerous sizes and gauges of steel tubing. Each specimen is inspected before and after welding and the operator graded accordingly. These specimens are frequently sawed through the weld and all errors and faults pointed out.

The fifth week brings a variety of metals to their attention. Cast iron welding for one day. Brazing and bronze welding on Steel, Cast Iron, Malleable Iron, Copper and Brass for one day. The remainder of the fifth week the Aluminum field is entered. Coupons, 3 x 3 in. are cut from sheet Aluminum. A flange of ⅛ in. is turned to a 90 degree angle, then a weld executed. This is repeated until the student has qualified. Then the plain butt joint is welded, using a filler. Finally, different angles are welded until the student can truly weld, readily and smartly the lighter gauges of Aluminum. The student is allowed one half day for cast Aluminum on an inexpensive set-up, and one practical weld on an Aluminum gasoline or oil tank.

The sixth and last week will find the student bending Steel, Copper and Aluminum tubing, which has been filled with dry sand, for the first day. The second and third day cutting is performed by each student on thick sections of mild steel, steel rails, pipe and I-beams. The fourth day, each is allowed to choose a favorite specimen, favorite metal and weld it in a favored position, which is a review. Much emphasis is placed on this choice and a critical inspection follows by the instructor. The remainder of the week is spent in repair and clean up of equipment in preparation for the following class.

The best equipment obtainable is used and it is never abused. No stone is left unturned and no authority disregarded in an effort to produce a capable, efficient and conscientious welder. In fact, a large number of the graduates are truly qualified welders although the course is regarded as only an elementary one.

†*Aviation Mechanics' School, U. S. Naval Training Station, Great Lakes, Illinois.*

Problems Encountered in Flash Welding*

Determination of Necessary Flash and Upset—Effect of Secondary Piping—Comparison of Flash and Roll Welds — Extent of Cold Working Effect

By E. R. Torgler†

THE following four problems were encountered in the flash welding of mild steel middle rings for Dresser Pipe Couplings and the solutions are offered as points of general interest to those who are concerned with the application and the development of the process.

Before taking up the individual problems in detail, a description of Dresser Pipe Couplings will clarify the application of the solutions for the reader.

Dresser Couplings are standard flexible pipe joints without threads and are made in all standard pipe sizes, both steel and cast iron, from 3⅛ in. to 72 in. in diameter. They are composed of a flared middle ring, two wedge shaped gaskets of a special rubber compound, two follower rings or flanges, and a number of bolts, the number depending on the size of the coupling. The method of manufacture is not the same for all sizes, but in this paper we shall consider only the method used in the manufacture of from 8-in. diameter to 26-in. diameter couplings, inclusive.

Middle Rings

The middle rings are made from mild steel bar stock which is rolled in the special Dresser sections by The Carnegie Steel Company. These sections are shown in the Carnegie Shape Book. The widths are either 5 in., 7 in., 8 in. or 10 in. and the thicknesses ¼ in., 5/16 in., 11/32 in., ⅜ in. and ½ in., depending on the size of the coupling and the pressure in the line to be coupled. The steps in the manufacturing process are as follows:

1. Cold shearing of the bar steel to the correct length.
2. Cold rolling of the sheared lengths to the desired diameter.
3. Flash Welding. This is done on flash welding machines very similar to those used in the flash welding of automobile tire rims. A middle ring weld must be absolutely non-porous. The working pressure on a coupling is applied from within the pipe line and when in service, the weld is under tension. The welding cycle is automatic.
4. Cooling of the flash welds. The rings are run through a water spray as they come from the flash welders in order to cool the metal before chipping the flash from the welds. The metal tears if it is chipped hot and is much more difficult to handle.
5. Chipping the flash from the welds. The flash is removed by pneumatic chipping chisels or by a flash shearing machine of special design. The inside of the weld is chipped flush with the inside circumference of the ring while a small ridge of upset metal is left on the outside of the ring to give added strength to the weld.
6. Grinding the inside of the flare at the weld. This is done to insure a smooth surface for the wedge shaped rubber gaskets.
7. External cold sizing. The rings are placed between two semi-circular dies and pressed to the desired outside diameter.
8. Internal cold sizing. The desired inside diameter is obtained by forcing hardened tool steel plugs into the rings in a bulldozing press especially designed for the purpose.
9. Testing the welds for leaks. The rings are clamped between two rubber discs and 90 lb. air pressure is applied inside the ring while the outside of the weld is painted with a soap solution. Any defects in the welds are thus very easily detected.
10. Cleaning loose mill scale from both the inside and the outside of the tested rings. This is done with a wire buffing wheel on a portable grinder.
11. Final inspection. At this point in the process the rings are thoroughly inspected for defects in material and in workmanship, and if any defects are found the rings are either scrapped or sent back to the appropriate point in the production line for repairing.
12. Drying. The rings are then run through a small drying oven to remove all traces of moisture.
13. Application of rust-proof coating. The specified rust-proof shop coating is applied by painting, dipping, or spraying and the rings are then hung on the overhead conveyor which takes them to the car or to the stock piles.

Flanges

The flanges are hot press formed from low carbon plate steel of thicknesses of ¼ in., 5/16 in., 11/32 in. and ⅜ in. The steps in this process are:

1. Cold blanking the steel plate into "doughnut" shaped rings.
2. Heating these blanks in a continuous automatically controlled furnace to 1850 degrees Fahrenheit.
3. Forming or first hot press operation.
4. Flaring or second hot press operation.
5. Heating the partly finished flanges in another continuous automatically controlled furnace to 2000 degrees Fahrenheit.
6. Belling or final hot press operation.
7. Heat treating. The hot flanges from the belling press are quenched in cold water which treatment toughens them materially.
8. Bolt holing. The bolt holes are punched cold, using a soap solution for a lubricant.
9. Cleaning. The loose mill scale is brushed from the flanges in the same manner that it is removed from the middle rings.
10. Inspection. Each flange is carefully inspected for defects in material and workmanship.
11. Protective coating. The specified rust-proof shop coatings are applied by painting, dipping or spraying, after which the finished flanges are hauled on industrial railroad trucks to the cars or to the stock piles.

Middle Ring
PROBLEM NO. 1

SUBJECT: THE DETERMINATION OF THE NECESSARY FLASH AND UPSET (BURN AND JAM) FOR A SATISFACTORY MIDDLE RING FLASH WELD.

Occasion—It was desired to determine whether a saving in metal might be affected by decreasing the amount of burn and jam in our regular flash welds. The regular practice was a ⅜-in. burn and a ⅜-in. jam on ⅜-in. steel. At the time the question arose we were making 22-in. diameter middle rings from ⅜-in. x 7-in. bar steel, so it was decided to investigate the welds on this section first in order to come to some tenta-

*Paper presented at the Fall Meeting, A. W. S., Boston, September, 1931.
†Metallurgist, S. R. Dresser Mfg. Co.

give conclusion as soon as possible and, later, to check these results by a similar investigation of welds made on our other standard sections.

As a certain amount of upset metal desirable on the outside of the finished rings we did not think it practical to decrease the jam to less than ¼ in. Accordingly a jam of ¼ in. was decided upon as the minimum. If we were able to make acceptable welds using a ¼-in. burn and a ¼-in. jam, we would affect a maximum saving. If this were not practical, we would try a burn and jam somewhere between ⅜ in. and ¼ in.

The welding machines were installed exactly as recommended by the manufacturer and no attempt was made to change this installation in any respect.

If we were able to successfully adopt the ¼-in. burn and ¼-in. jam we would save 0.186 lb. of steel per weld or about 558 lb. of steel for every 3000 middle rings. In addition to this there would be an increase in production from the welding machines due to the decreased welding time and there would be less flash to be chipped from the welds.

Procedure—Ten 22-in. middle rings were welded using ¼-in. burn and ¼-in. jam. The welds were chipped and carefully inspected on both the inside and outside surfaces. No surface defects were observed. Two of these rings were selected at random and from each ring two sections were cut, at right angles to and including the weld, one for macro and one for micro examination. The sections were taken about half way between the outside edge of the flare and the center rib. At the same time two rings were selected at random from the regular production where the ⅜-in burn and ⅜-in. jam had been used and similar sections were cut for macro and micro examination. One section from each ring was polished and etched in 5 per cent nital for microscopic examination and one section from each ring was rough polished and macro-etched in a hot 50 per cent solution of hydrochloric acid.

Results—The macro-etched sections showed clearly the difference in metal consumed in the two welding procedures. No defects in the line of weld were noted. There was a noticeable banding in the steel which is common to all hot rolled sections and at the welds where the metal was upset there appeared to be a marked tendency for the bands to separate slightly, due to the upsetting or jamming. In other words, the metal which had been upset appeared to be less dense than the parent metal which had not been heated in the welding operation. Where the ¼-in. jam had been used the apparent separation of the bands was less pronounced. From this it was a reasonable assumption that if the upsetting was responsible for a decrease in the density of the metal at the weld we might expect this effect to be less marked where the upsetting was cut down to a minimum.

The microscope revealed very little difference between the sections illustrating the ¼-in. burn and jam and the sections illustrating the ⅜-in. burn and jam. The polished sections all showed complete union of the grains at the line of weld and no excessive grain growth where the heating effect was most pronounced. The sections illustrating the ¼-in. burn and jam appeared to be slightly finer grained throughout, which is an indication of a stronger weld, but the difference was very slight.

Conclusions—The above seemed to be conclusive proof, so far as could be determined by the microscope and the macro-etched sections, that we could safely adopt the ¼-in. burn and the ¼-in. jam when welding ⅛-in. x 7-in. steel. If there were any difference in the quality of the welds it seemed to be in favor of the smaller burn and jam.

We adopted the ¼-in. burn and jam for the ⅜-in. x 7-in. steel at once and did not run into any trouble with the welds even though they were inspected much more thoroughly than before. This, as pointed out in a foregoing paragraph, has the maximum saving we could make and still produce welds which were acceptable to our inspection department so it was not necessary to experiment further. We later decreased the burn and jam used on all sizes of steel without running into any difficulty.

PROBLEM NO. 2
SUBJECT: SECONDARY PIPING AND SEGREGATED IMPURITIES AS CAUSES OF DEFECTIVE FLASH WELDS.

Occasion—One of the first problems called to my attention at the Dresser plant was the occurrence in the flash welding department, at not infrequent intervals, of welds which when chipped exhibited decidedly pitted surfaces. The pits did not always occur directly in the line of weld. Sometimes they were found as far as ¼ in. to either side.

The welders complained that something was wrong with the steel as they would run along for several days with comparatively few bad welds and all at once as high as 20 per cent defective welds would appear for a short period with absolutely no change in the welding operation. Other men in the department felt that some change in the welding operation had been made and that the welders were not aware of it.

A great many of the defective welds were beyond repair.

Procedure—A typical pitted weld in a 22-in. diameter middle ring made of ⅜-in. x 7-in. steel was selected. A section for microscopic examination was cut at right angles to the weld about half way between the outside of the flare and the center rib. The section was polished and etched in 5 per cent nital and six photomicrographs were taken to illustrate the different zones of the weld and the occurrence of the pits which were causing the trouble. The same section was then macro-etched in a 50 per cent solution of hydrochloric acid.

Conclusions—The photographs showed rather conclusively that the pits were due to the presence of the impurities which were segregated in rather narrow lines in the direction of rolling. These lines showed a tendency to part where they came to the surface due to the upsetting. In some cases, where the larger pits occurred, the impurities were so numerous that the lines resembled laminations rather than just segregations.

I was of the opinion that we were either getting dirty steel or that the steel mill was not cropping enough off the ingots. Prior to this investigation a number of men from the steel mill had visited our plant on this very problem, but they all reported that they believed the trouble to be due to some unknown variation in our welding process and not due to any variation in the steel. When my report was completed we called in representatives from the steel company and they agreed that the steel was at fault. They promised to investigate the matter thoroughly at the mill with the result that we have encountered no more pitted welds, although my report was dated Oct. 27, 1929.

Aside from their relation to the pitted welds, these photomicrographs are of unusual interest because they show very plainly the effect of the heating during the welding operation on the adjacent metal. Beginning at the line of weld and moving either right or left at right angles to it we found three distinct zones which were produced by the welding and which blend into each other. At and in the immediate vicinity of the line of weld we find a rather narrow zone of fine grains where the refining effect of the upsetting more than offset the tendency to grain growth produced by the welding heat. This zone blends into another comparatively wider zone of enlarged grains where the tendency of the grains to grow predominated. This we would expect to be the weakest section of the weld. These enlarged grains grade into another zone where the grains have been refined due to the upsetting.

PROBLEM NO. 3
SUBJECT: A COMPARISON BETWEEN A FLASH WELD AND A ROLL WELD ON THE SAME SIZE MIDDLE RING.

Occasion—When we were considering the installation of a new middle ring department, along with a number of other additions, to increase the capacity of the Dresser plant the question of roll welding versus flash welding was discussed at length. We knew of one plant where they were roll welding middle rings of a section quite similar to the Dresser sections

and we were all interested in determining the relative merits of the two methods before deciding on new equipment.

The roll welds were made, we had been told, by rolling the entire rings over a mandrel after they had been heated to the welding temperature, the ends having been lapped before rolling.

Procedure—We secured a 20-in. diameter roll welded middle ring made of 5/16-in. thick steel. We then selected a Dresser flash welded ring of the same diameter and cross section. Three sections were cut at right angles to the roll weld about half way between the outside edge and the center rib. The three sections included the entire weld, that is, when laid end to end they made up a complete cross section. Two similar sections were cut from the flash welded ring at right angles to and including the weld. All five specimens were polished and etched in 5 per cent nital.

Conclusion—The photomicrographs were quite strong evidence in favor of the flash weld. With a decidedly better union of grains at the line of weld, with the absence of inclusions at or near the line of weld, and with a much finer grain structure throughout, our natural conclusion was that the flash weld is more effective and more satisfactory, from the standpoint of performance, than the roll weld. We would expect the flash weld to be stronger and more ductile.

However, we must not lose sight of the fact that we have only examined one roll weld. All roll welds might not give such bad accounts of themselves, although there is no reason to suppose the weld we examined not to be a typical one. Also, in considering the probable comparative tensile strength of the two welds, we must remember that the line of weld in the roll weld was a little over 2 in. long, due to the lapping, while the line of weld in the flash weld is only as long as the thickness of the metal welded plus the amount of upset metal which remains after chipping. Even though the line of weld in the roll weld is interrupted by voids and by flux slag inclusions the sum of the areas where these interruptions do not occur may be great enough so that a tensile bar cut at right angles to the weld would not fail through the weld itself.

On the other hand, from this evidence and from our knowledge of the two welding processes we would expect voids, slag inclusions, and enlarged grains in any roll weld, while we would expect the flash welds to be cleaner and finer grained. The finer and cleaner structure is always the more desirable from the standpoints of tensile strength, ductility, and also resistance to corrosion.

PROBLEM NO. 4

SUBJECT: TENSILE TESTS OF MIDDLE RING FORMED SKELP BEFORE PROCESSING. AT DIFFERENT POINTS DURING THE PROCESSING, AND AFTER PROCESSING IN OUR FLASH WELD DEPARTMENT.

Occasion—As explained before, the flash welded middle rings, while they are being fabricated, are subjected to rather severe cold working when they are bent and later cold sized both externally and internally. We expected that this cold working increased the tensile strength and the yield point of the steel with a corresponding loss in ductility and were therefore desirous of determining the extent of this cold working effect.

Procedure—We arranged to have all the tensile tests made at Case School in the Department of Mechanics & Hydraulics.

We were working on quite a large order of 24-in. diameter x 3/8-in. x 7-in. middle rings so it was decided to use these rings for the tests.

As most of the tests would have to be made on test bars prepared from finished or partly finished rings we first considered the possibility of using, as test bars, complete circular sections of the rings to be tested, milled to a uniform width. Professor Danforth, head of the Department of Mechanics and Hydraulics at Case School, was consulted in the matter and he explained that we could make such tests providing we first made special yokes and mandrels according to the sketches he submitted. (We later made the special yokes and mandrels as Professor Danforth suggested and found them very satisfactory for testing the welds in 24-in. middle rings. These tests are more favorable to the weld than the tests described below.) This would mean considerable delay in obtaining the desired information so the tests bars were prepared as follows:

Eighteen-inch sections, including the entire width, were cut from the rings with an acetylene torch. Where it was desired to test the welds, the sections were cut with the weld at the center. The sections were then flattened between special plates in a hydraulic press. The test bars were milled from the flattened sections and were all cut next to the center rib of the ring.

Thirty-six coupons were prepared as follows:

Nos. 1 to 4 inclusive—Taken from the bar steel as it comes from the steel mill.

Nos. 5 to 13 inclusive—Taken from the rings after they had been cold rolled and welded but not chipped. Nos. 5, 9, 10 and 11 were outside the weld, while Nos. 7, 8, 12 and 13 included the weld.

Nos. 14 to 21 inclusive—Taken from rings which had been cold rolled, welded and chipped. Nos. 14, 15, 18 and 19 were outside the weld and Nos. 16, 17, 20 and 21 included the weld.

Nos. 22 to 29 inclusive—Taken from rings which had been cold rolled, welded, chipped and cold sized. Nos. 22, 23, 26 and 27 were outside the weld, while Nos. 24, 25, 28 and 29 included the weld.

Nos. 30 to 37 inclusive—Taken from finished rings which had been cold rolled, welded, chipped and cold sized. The welds in these rings had been sprayed with cold water as they came from the welding machines. Nos. 30, 31, 34 and 35 were outside the weld, whiles Nos. 32, 33, 36 and 37 included the weld.

The steel used in the tests was open hearth skelp steel of the following analysis:

Carbon	.08%
Manganese	.48%
Phosphorus	.013%
Sulfur	.042%

The results of the tests are shown in Table I.

The uniformity of this steel is truly remarkable, even though all the bars were of the same open hearth heat.

Note that the yield point and ultimate strength of the one bar which failed in the weld were not below the average.

Conclusions—The following points are worthy of comment:

(1) These tests indicate that our cold working in the Flash Weld Department increases the elastic limit of the middle ring steel about 4% and increases the ultimate strength about 8%. There is a decrease in elongation of about 30.7% and a decrease in reduction of area of about 8.7%.

(2) Of the sixteen coupons which included the flash weld, only one failed in the weld itself. This failure was not in the line of weld but through the section where the largest grains are found, immediately next to the line of weld. Even in this coupon, the yield point and ultimate strength were not below the average. This is quite conclusive evidence that our flash welds are stronger than the parent metal.

(3) In coupons Nos. 30 to 37 inclusive, where the flash welds were quenched in cold water as they came from the welding machines, no variations in the physical properties were noted. This was not intended as a heat treatment but we found it desirable to cool the welds quickly due to the difficulty in chipping them while hot. By the time the rings reach the water spray the welds are below the critical temperature, so the quench has little or no effect on the properties. This verified our opinion that we could water cool the welds without running into any difficulty.

Table I

Bar No.	Yield Point, Lb./Sq. In.	Ultimate Strength, Lb./Sq. In.	Per Cent Elongation 8 In.	Per Cent Reduction of Area	
1	29,830	45,500	33.2	65.6	
2	29,750	45,500	33.3	65.2	
3	29,880	45,800	34.8	65.8	
4	29,650	45,700	34.4	65.6	
5	30,900	47,700	30.5	65.2	
7	31,300	48,600	23.5	56.5	Welded
8	31,550	48,900	21.6	62.1	Welded
9	.....	48,500	26.8	64.9	
10	30,940	48,350	29.7	64.8	
11	31,460	49,000	27.7	63.4	
12	30,540	49,350	20.5	56.2	Welded
13	30,820	49,000	19.6	63.3	Welded
14	30,330	48,400	28.4	63.7	
15	31,310	49,250	24.0	58.7	
16	31,550	50,100	18.1	57.1	Welded
17	31,230	49,400	22.8	58.0	Welded
18	30,430	48,600	27.8	64.8	
19	30,110	49,000	22.2	64.8	
20	31,140	49,200	21.0	62.5	Welded
21	31,540	49,400	20.8	57.9	
22	31,560	49,500	23.1	64.3	
23	30,960	49,700	23.0	61.4	
24	31,750	49,450	22.5	63.5	Welded
25	30,970	49,400	21.5	58.5	Welded
26	30,450	50,300	21.0	63.2	
27	31,560	49,900	21.5	63.7	
28	30,400	49,600	22.5	64.3	Welded
29	30,320	48,600	12.5	23.3	Failed in weld
30	30,820	49,000	26.3	62.6	
31	30,470	49,800	23.8	57.5	
32	31,400	49,400	21.6	61.5	Welded
33	30,160	49,400	21.1	61.5	Welded
34	31,800	49,400	20.9	61.4	
35	30,450	48,900	21.5	62.9	
36	31,300	49,100	19.7	61.8	Welded
37	31,040	49,100	20.2	65.5	Welded

Demonstrate Versatility of Battledeck Flooring

Possibilities for variations in design of battledeck steel floor construction were exhibited before building experts, structural engineers, welding technicians and officials in charge of construction for the Cleveland Board of Education in a demonstration recently conducted in Cleveland.

Steel "battledeck" flooring has long been used on ships and open hearth charging floors and has been adopted in numerous office and industrial buildings. Its advantages are that it provides a lighter, stronger floor construction, reducing the dead load on the foundation columns; that each floor acts as a girder to prevent tortional distortion in event of wind or earthquake; that it will recover instantly to a full 100 per cent of its deflection due to live load, when that load is removed; that it will allow engineers to determine, in advance, the stress in all parts.

An innovation was the introduction of a method of affixing wood sleepers to the steel floors. In most cases, where a wood floor is not necessary, it has been customary to surface the steel plates with cork or tile. The use of wood sleepers not only allows wood flooring but, in residence building which is now turning to steel frame construction, provides a floor construction which offers the minimum of obstruction to pipes and conduits.

Wood 2x4's are laid on the plates and drilled. The drill goes through the wood and the plate. A patented nail of special steel manufactured by the Hill Wood Manufacturing Company, Cleveland, Ohio, is then driven through the sleeper, threading itself firmly into the steel as driven. Tests to remove the nails by wedges under the sleeper resulted in tearing off the wood without bending or starting the nail. Figure 1 is an isometric drawing of this type of battledeck construction with plug welds, showing the position of the wood sleepers.

The flooring in this demonstration consisted of $\frac{5}{16}$-inch steel plates, 4 feet wide, punched 24 inches from the edge of the plate with $\frac{11}{16}$-inch holes on 12-inch centers. Half holes were punched along the edges of the plates. This flooring was carried on 5-inch I-beams over a 20-foot span to support a live load of 75 pounds per square foot. The I-beams were spaced on 24⅛-inch centers.

In this demonstration the floor plates were fused to the I-beams by plug welds through the holes. These welds were made with the Lincoln Electric Company's electrode known as "Fleetweld". With $\frac{3}{16}$-inch electrodes these plug welds were made in less than 30 seconds each.

The recent adoption of battledeck flooring in several large buildings has focused attention on this method of construction. With arc welded steel frame homes of practical design now possible, the innovation of a method of affixing wood flooring to the steel points to the spread of battledeck floor construction in residence building.

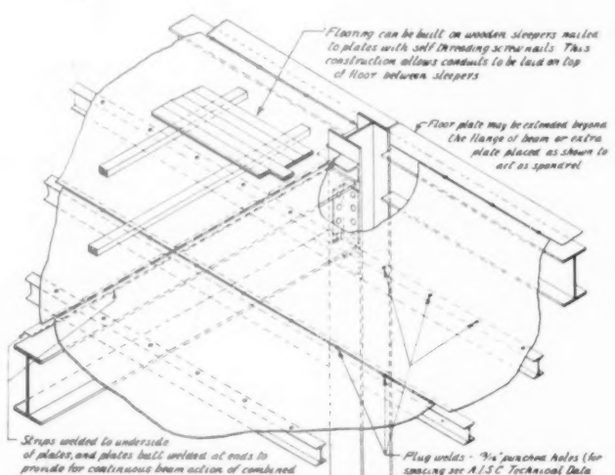

Flooring can be built on wooden sleepers nailed to plates with self threading screw nails. This construction allows conduits to be laid on top of floor between sleepers
Floor plate may be extended beyond the flange of beam or extra plate placed as shown to act as spandrel
Strips welded to underside of plates, and plates butt welded at ends to provide for continuous beam action of combined plate and beam section
Plug welds - 3/4" punched holes (for spacing see A.I.S.C. Technical Data Bulletin No. 3a) Plate width to span either two or three floor beams

Figure 1. Isometric Drawing of Battledeck Floor with Wood Sleepers.

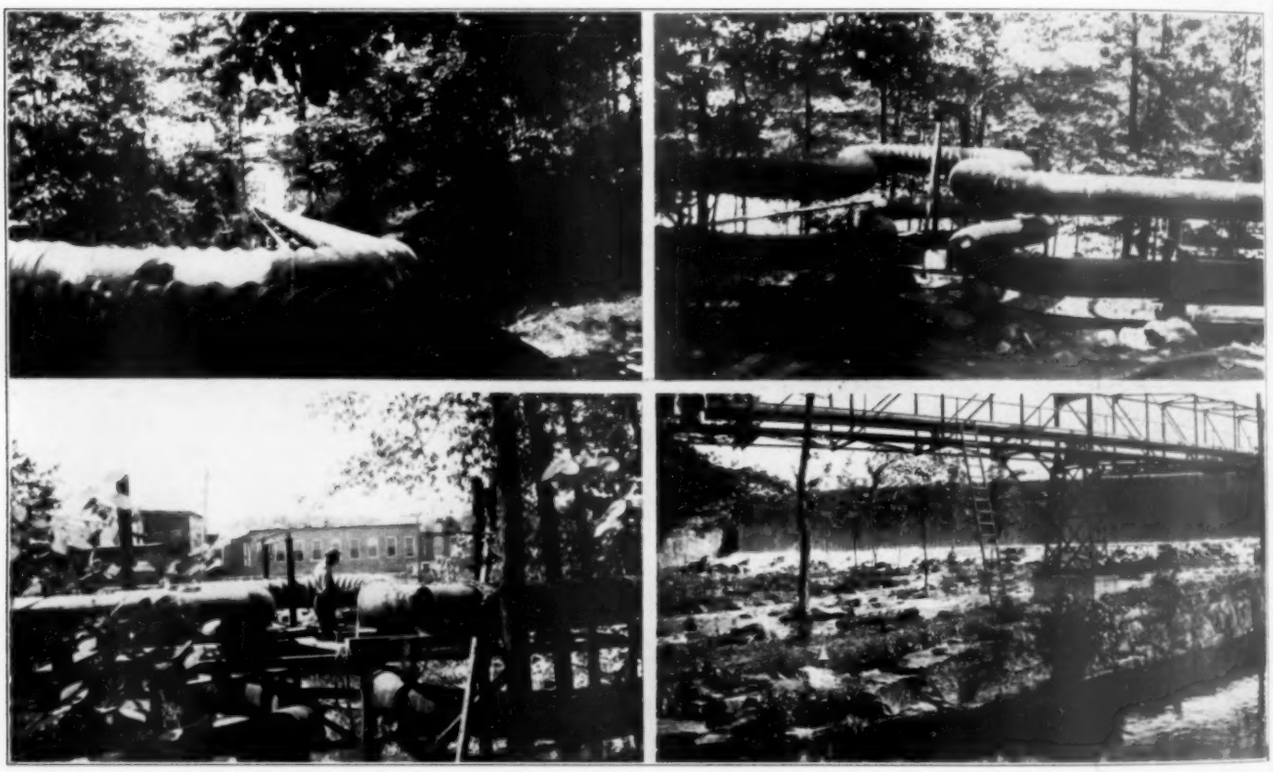
The demonstration was conducted by the Carnegie Steel Company in its Cleveland warehouse. The welding was done by The Lincoln Electric Company, of the same city. This type of battledeck floor has been endorsed for structural work by Lee H. Miller, chief engineer of The American Institute of Steel Construction.

Gas Welded Power Piping

An Installation of Over a Half Mile of Eighteen and Twenty Inch Pipe for Delivering Power from Central Plant to Distant Mills

By George F. Walker

OXY-ACETYLENE welding proved to be a highly satisfactory and efficient method of constructing power pipe lines in connection with some plant extension work recently conducted by the Crocker Burbank Paper Company of Fitchburg, Mass. This company operates nine paper mill plants in the city of Fitchburg, making it one of the largest groups of cut paper manufacturing plants in the country. They recently decided to build on an addition to their centrally operated power plant to take care of their ever increasing needs for power. Two new water tube boilers were installed in addition to three which they already had in operation, giving them a battery of five boilers with a total output of 8,000 horse power.



The Two Views Above Are of Expansion Bends in the Line. That on the Right Gives Some Idea of the Difficult Working Conditions Met in Making the Installation. Lower Left Is a View of Welder at Work on Elevated Pipe Structure. Lower Right Is a Portion of the Bridge Which Carries the Lines Across the River.

This project called for the installing of approximately 1,000 ft. of 20" O.D. pipe and 1,700 ft. of 18" O.D. pipe to provide a means of transportation of power from the central plant to their No. 8 mill which is located quite a distance from the power plant. The contract for this installation was awarded to the Jennison Company of Fitchburg, Mass. Oxy-acetylene welding was decided upon as the most desirable method for joining the lengths of pipe together to make this long run which ran over rough ground, through a woods, across a river, then paralleling the river under a state highway, through the yards of residences, and into a tunnel, before arriving at its destination in the mill.

The ground over which this line runs was very rough, and the soil was mostly a clay formation. This made the footing very slippery in damp and wet weather so that the workmen had to exercise considerable caution to prevent the various types of accidents which might result when working in such slippery material. The line was suspended on iron work that ran through the woods sometimes at a height of five or six feet from the ground, and sometimes at a height of eighteen or twenty feet in order to maintain the correct grade. It was therefore necessary to use a considerable amount of rigging and blocking in order to handle the lengths of heavy pipe under such difficult ground conditions. The 20" diameter pipe had to be skidded down a railroad embankment 35 ft high, and then hoisted up onto the rolls set in place to receive it. After two lengths were set up in the rolls, they were faced, spaced and clamped and then tack welded. Then they were hauled along the run and another length of pipe was hoisted in position and the same procedure followed until a run of eight or nine lengths had been packed together. The welding crew would then get into action with two men working on a joint. All the welds were made in position, it being impossible to make rolling welds on account of the position of the pipe and the danger of rolling it off the line.

The expansion bends were assembled in position, three sections to a bend. The expansion joints were of the corrugated type, with the creases in the throat. This type of expansion joint allows for a very much smaller radius to be used with pipe of such large diameter.

After the line was welded, it was raised to allow for inserting the covering protectors on the roll. These protectors were

then in turn welded to the pipe, allowances being made at every roll for travel owing to expansion and contraction. When we assembled the bends we blocked them up in position and then they were graded with a transit; then the straight lines were drawn to position. The bend was opened to allow for expansion and then welded into the line.

Above: A Straight Run of Pipe Through the Woods. Below: End View of Bridge Over the River.

It will be noticed that where the line crossed the river below the dam, all the piping had to be entered from one side of the bridge and carried all the way across, owing to the conditions that existed on the other side of the river.

A 4" return line was carried along and welded at the same time while the 20" and 18" lines were being welded.

Owing to the large diameter of this pipe and the long run involved, considerable interest was shown in the project by various power engineers, and there was a considerable amount of satisfaction in turning on the steam pressure when it was completed and noting that there was not a single leak anywhere in the whole line. This was the best possible answer for those skeptics who were doubtful about the possibility of obtaining such a thoroughly satisfactory job with this process.

The welding rod used for this job was the Oxweld No. 1 Hytest welding rod which the writer has found by experience to be thoroughly satisfactory for this type of work.

This installation is one of the longest power lines of its size in the east, if not in the whole country. The success which we had when installing it certainly proved that the oxy-acetylene welding process is not one which requires the setting up of ideal conditions. In this case we had to contend with all kinds of ground conditions and therefore it would not be surprising if the workmanship had suffered on account of the necessity for each man having to take extra precaution to avoid accidents. The fact that no such evidence was found and also that ehere were no mishaps while the installation was being made shows that it pays to take all of the working conditions into account and go about the job with the idea of doing it faithfully and of getting the desired results the first time instead of rushing it through and taking unnecessary chances for the sake of hanging up new speed records.

Although there are still some engineers who are a little bit doubtful about the use of welding on power piping, the process is really in high favor in this part of the country because so many splendid welding jobs have been done, and the owners of the plants in all cases have been thoroughly satisfied with the results. The secret is in the careful planning of the work and in taking care to use good men, good materials and procedures which have proven to be satisfactory.

Future plans of this company contemplate additional installations. A branch tee nozzle was welded on the line before crossing the river to allow for a future 10" line which will be run almost a mile in length to another mill belonging to this same group.

New Improved Type Buoys Are Electric Welded

Improved all-electric-welded buoys for use in the Los Angeles Harbor are being constructed by the Wilmington Welding & Boiler Works at Wilmington, California. These buoys, a few of which are shown by the accompanying photograph, are a marked improvement over the old cone-shaped riveted type of the past. Being flat, the new type lie flat on the water and are more readily seen.

These buoys are made of 14-gage sheet metal with all electric welded seams. To the bottom side of the buoy, (as noted in the picture) is welded a second hand Ford tire rim on which, before the buoy is put into service is mounted and inflated, an ordinary tire and tube. The tire being on the bottom side of the buoy when it is placed in the water, lies flat on the surface and thus provides excellent protection against damage to the sides of small boats and launches which frequently come in contact with the buoys. This idea of a tire used as a protective measure is noteworthy.

The New Welded Buoys.

An anchor ring is welded on the bottom in the center to which is attached the anchor chain. When the buoys are ready for placing in their locations, old railroad car wheels or similar weights are fastened to the bottom end of the anchor chains and lowered to the bottom for holding the buoys in their proper location.

International Bridge Engineers Follow Welding Developments

A report of the second meeting of the Permanent Committee of the International Association for Bridge and Structural Engineers outlines the preparations which have been made for a program to be held in Paris, France, May 19 to 24, 1932. The third subject on the list is that of Welding in Steel Structural Work. This subject will be covered by four papers. First—a general report; second—a paper on the strength calculation and structural form of welded steel connections, and third, a review of the experience gained in practice. Fourth—a discussion of the combination of riveted and welded connections.

Further details can be readily obtained by application to the Secretary of the International Association for Bridge and Structural Engineering, Federal Polytechnical University, Zurich, Switzerland.

Pontoon Roofs for Large Tanks Require a Variety of Welding

One of the most modern types of roof construction for large storage tanks in the Wiggins pontoon roof, made by the Chicago Bridge & Iron Works, Chicago, Ill. This is a floating roof built with a ring of pontoons around the outer edge, making it non-sinkable. Although the pontoons are constructed in a continuous ring, they are separated by bulkheads which make each section act as an individual pontoon. These roofs are usually of all-welded construction, and the complete job involves a variety of types of plate and structural joints. The amount of skill required for the design and construction of one of them is best illustrated by reference to the accompanying photographs.

The structural supporting framework must first be constructed in the bottom of the tank so that the roof rests on it when the tank is empty. Figure 1 shows a roof support for a Wiggins pontoon roof on an 82,000 barrel tank. This support is constructed entirely of angles and is welded directly to the bottom of the tank.

The tank is equipped with an improved flexible joint drainage system, and Figure 2 is a close-up showing the center plate, the sump and pipe drainage system of a Wiggins pontoon roof under construction.

After the supports and drainage system have been completed, the deck plates are laid on the support and tacked in place for welding. Figure 3 shows the deck plates partly in place and the preliminary assembly well under way on one roof.

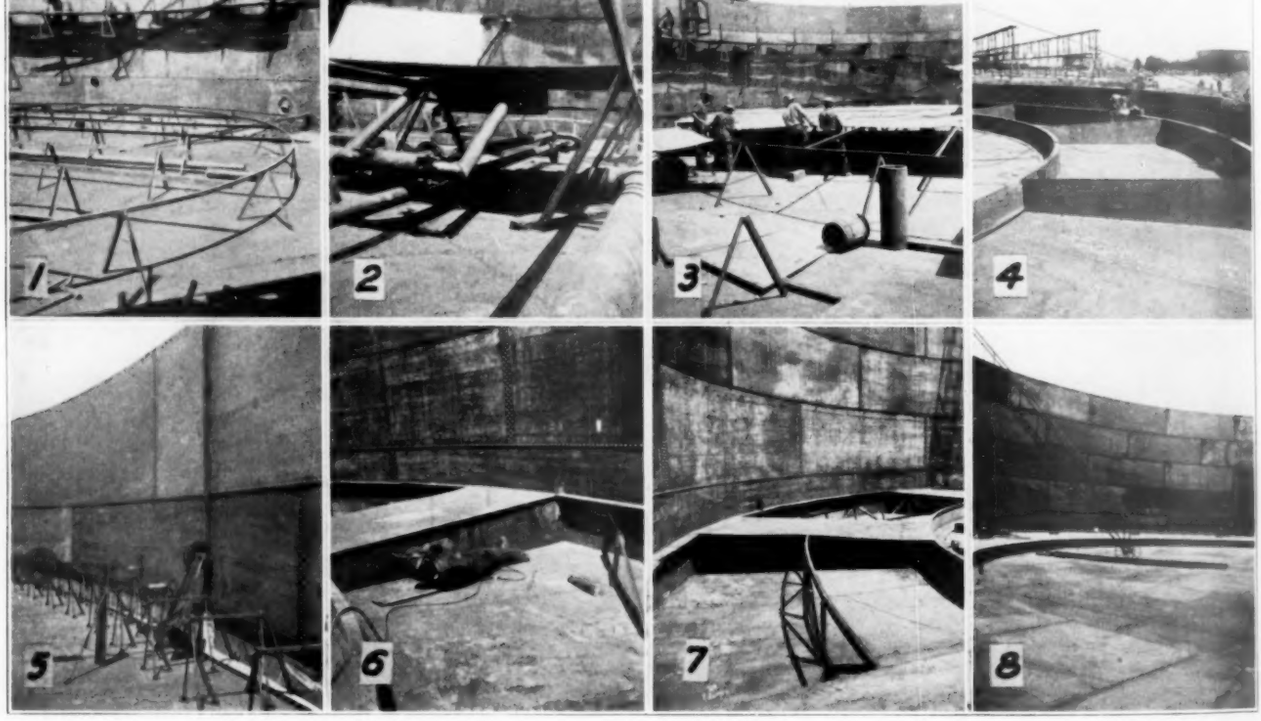
Figure 4 is a view of a pontoon section under construction. The plates in the lower part of the deck are bent on a bending brake to form the outside rim of the pontoon. The inner ring of the pontoon consists of a 12 inch channel bent to the proper radius. The bulkheads are separate sheets welded into position at regular intervals, forming individual pontoons.

On these large tanks it is necessary to provide a seal to close the space between the roof deck and the tank shell. This seal forms a long sliding contact. Figure 5 is a close-up of the edge of a roof showing the guiding arrangement which prevents the roof from rotating in the tank. This view also shows the hangers which support the shoes and keep them in close contact with the tank shell.

It is, of course, necessary for the pontoons to be both strong and tight. Figure 6 shows a workman welding the upper plates of a pontoon to the bulkhead which separates the individual pontoons. Figure 7 is a view of the supporting framework which is welded along the center of each pontoon.

Figure 8 is a general view looking across a completed roof. This installation is on an 82,000 barrel tank. The ladder, running from the edge of the tank to the deck of the roof, is also of welded construction.

These photographs were taken at the Chicago terminal of the gasoline pipe line completed this year by the Great Lakes Pipe Line Company. This terminal is located at Franklin Park, Ill., and the tank work at this point included four 82,000 barrel tanks with the type of roof described above. This pipe line company is owned by the Continental Oil Company, Barnsdall Oil Corporation, the Mid-Continent Petroleum Corporation, Skelly Oil Company, the Pure Oil Company and the Phillips Petroleum Corporation. It transports gasoline from refineries in Oklahoma and Texas for delivery to Kansas City, Omaha, Des Moines, Chicago, Minneapolis and Milwaukee. 72 of the storage tanks used in the system are equipped with the Wiggins pontoon roof. These range from 36 ft. to 120 ft. in diameter and from 35 ft. to 41 ft. in height. It is obvious from these figures that construction of these pontoon roofs by welding was a welding job of impressive dimensions.



Views of Welding Operations Involved in Construction of Wiggins Pontoon Roof for 80,000 Barrel Storage Tank.

Locomotive Wheel Flanges

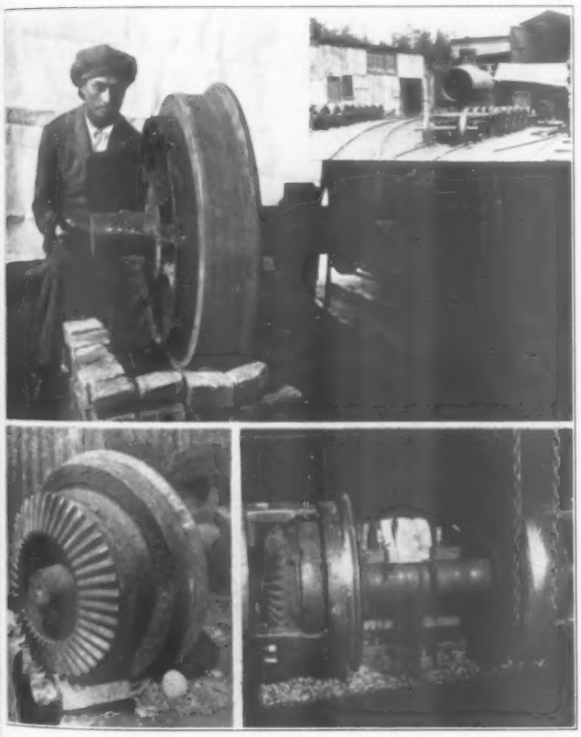
Out of 847 Flanges Welded in a Five Year Period Only Seven Failed—Seventy-Six Flanges Were Returned for Rewelding After an Average Life of 689 Days of Service

By El Soldadora

DURING the past 5½ years the writer has had to direct the welding of a total of 847 locomotive and car tire flanges with a loss of but seven. Before proceeding with the discussion, I shall describe the tires and wheels and the peculiarities of the road upon which they operated.

In the summer of 1923, while in San Francisco, I rode on the Mt. Tamalpais line, advertised as "the world's crookedest railroad." This is an old tailing of ours—"the world's greatest" this and that. A year later I was speeding up the west slope of the Andes, over a railroad unknown above the Tropic of Capricorn, but which contained more curves than I ever hope to ride over again.

I doubt that anyone can say with any degree of certainty just how many miles of track is in this road. Gangs of men are continually cutting out curves. The length of this road changes from week to week, and I had been informed that 50 curves were removed in one of the years that I had been there, and this sort of thing has been going on for years. This road



Above: Welder at Work Rebuilding Tires. Lower Left: A Shay Locomotive Wheel. Lower Right: Turning a Flange Down to Standard Gauge. Insert Above Is the Tire Welding Shop.

was about 44 miles long, and it rose from an altitude of 1500 to 7000 feet.

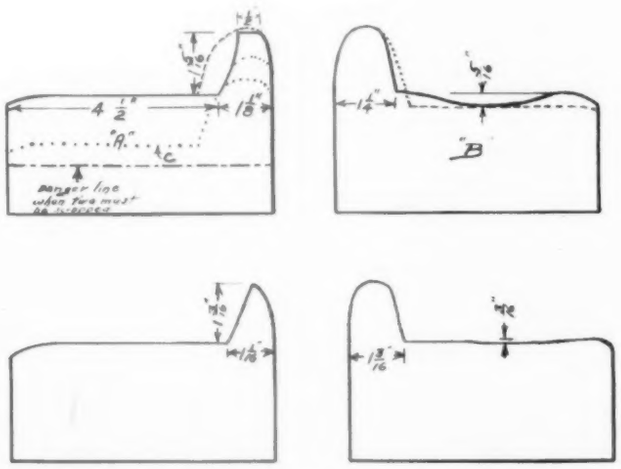
The types of wheels and tires varied as follows:

1. Shay locomotive tires
2. Car wheel tires
3. Car wheels—cast steel
4. Automobile wheels—cast steel
5. Car wheels, manganese, for electric railroad.

The great majority of our work was on the Shay locomotive tires and car wheel tires.

It seems difficult to lay down any set rules for the welding of tire flanges. Each of the above mentioned tires and wheels seemed to present a problem of its own.

This was an immense organization that had suddenly decided to adopt electric welding. They bought a second-hand portable machine, secured an operator and began welding. A few



Sketch Showing How Tires Wear and Method of Reclaiming Them.

months later we arrived on the scene. They were welding a tire. "When did you start this?" I asked. "A few days ago," was the reply. "And when will you finish?" "In a few days." No one knew just what could be done, and so they had a fine time they welded about 18 inches a day.

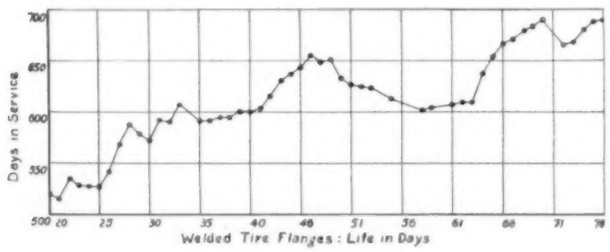
Upon arrival of new machines, the welding of these tires began in earnest. This was in December, 1924. Remember, there were no welders on the market. We trained our own as a study of the chart will show; this will come in its place.

Here we discovered that these tires could not be welded "as is." They were shrunk on rather tightly. We tried a wood fire for preheating, as shown in one of the photographs, for a period of one hour before starting the weld. Following the hour of preheating, we limited the fire to the far end of the wheel, first for the convenience of the operator, and secondly for the purpose of keeping the tire hot during the eight hours now used to weld a tire of 9½ feet (lineal) of welded flange. The finished tire was covered with asbestos paper and allowed to cool overnight. In the morning it was rolled out and put in the wheel lathe where the flange and tread were turned down to the standard gauge.

In those early day our welding procedure was as follows: We laid our first layer with Wilson No. 4 electrodes—a high carbon content rod. We then laid the second and finishing layer with Armco mild steel electrodes. Our idea or rather belief was that the Wilson No. 4 was not machineable. In this we were mistaken, and after several months discontinued

this practice and welded the flange entirely with No. 4. The chart curve will also show that this change no doubt had its effect on the life of a welded tire. During these first six months we welded 103 tires and 3 of these broke during the cooling. These 3 failures made us increase our preheating time to 2 hours. During the next year we welded 178 tires with a loss of 2.

Welding there, as everywhere, has its critics and the rumor had it that a welded flange only "stood up" a few weeks. We knew that this was untrue. We knew the engines were working. It had always been a bad fault of ours to worry about each new job, and so we were rather discouraged about such unfair criticism. So we began a system of centre-punching the ends of the axles in an effort to keep a better record of the tires, but I must admit that although it put an end to the anti-welding critic, it gave us no exact check on these tires, because of the 847 sets of tires that were welded, only 76 of



the marked tires returned for rewelding. And so our data on the life of these welded tires is limited to the 76 pairs on which we have accurate knowledge. Also, our data is limited to "days in service." No data was available for a record of miles run.

A glance at our chart shows a vast difference in the first twenty and the last twenty tires that returned for rewelding:

Tires No. 1 to 20—average life in days of service 520
Tires No. 56 to 76—average life in days of service 999
Tires No. 1 to 76—average life in days of service 689

The vast improvement in groups No. 1 and 2 is due to either or both facts that the efficiency of the welders had increased and we had discontinued the practice of using a finishing layer of mild steel rods.

It was generally thought that the life of a new tire was one year. In an effort to arrive at a more definite figure, in September, 1926, we marked two sets of new tires. These returned, the one set after 402 days' service and the second set after 845 days. And again, in May, 1928, when we thought that the efficiency of the welders was at its highest, we marked another new set of tires and these returned after 477 days.

And so, by way of comparison, we have

12 new tires with average life of 575 days in service.
76 welded tires with average life of 689 days in service.

When we speak of "days of service," we refer to such time as the tire flange had worn to the danger-point.

Another noticeable point in these tires was that of each pair, one tire would show excessive wear on flange and no wear on tread and the other tire would show just the opposite in wear. The sketch will show condition of tires from two different engines. It may be noticed that in these sets, the one tire shows all the wear on the flange and the other shows the wear mostly on the tread. We have never attempted to weld the tread on these locomotive tires, alhough we have welded "flat spots."

And so, we shall see the procedure with Set No. 1, when the arc welding process is used. The tires arrive in the Welding Shop preheated, and the operator, armed with a gauge showing size to which flange must be rebuilt. The welding finished, the tire is allowed to cool and then placed upon a lathe (wheel lathe) and the tread in "B" is turned down as shown by dotted lines. Also armed with a gauge the latheman now shapes the flange. The diameter (tread) of wheel is now taken and the opposite tire "A" must now of necessity be turned down to this diameter. And so our set of wheels go back into service with the thickness of the tire diminished but 5/16".

And now let us fancy the same set under the pre-welding system. Tire "A" would have to be turned down until enough metal was available to shape the flange. This would bring the line of our tread down to the dotted line "C." One can readily see what the life of a tire was under this procedure. The ultimate life of a tire where the arc welding process is in use is not definitely fixed, but our records show the following:

Tire Mark	1st Weld	Days in Service	2nd Weld	Days in Service	3rd Weld	Days in Service
.05	Jan. 7, 1926	465	Apr. 15, 1927	655	Jan. 30, 1919	
X9	Nov. 6, 1925	535	Apr. 25, 1927	746	Scrapped May 11, 19	
BI	Aug. 28, 1926	352	Aug. 18, 1927	372	Aug. 31, 1929	74

There were many tires still in service that had been welded three times and as we said adios to our Chilean friends, these tires were still carrying copper to the sea.

And so our record of tires and wheels comes to an end—847 flanges welded during five and one-half years. Of these but 7 broke due to contraction strains. Of these, but 76 returned to be welded a second time; and these 76 had an average life of 689 days in service.

While on this subject it might be interesting to note that the technique of welding these tire flanges was readily acquired by the "poorer" class of welders—those whom the boys in this section of our republic term "ham bologna" welders. These men, accustomed to handle but the most ordinary class of work became quite expert with the Wilson No. 4 electrode, whereas the few expert welders we had could never quite perfect themselves to the peculiarities of this high-carbon electrode.

Welded Railings Used for Century of Progress

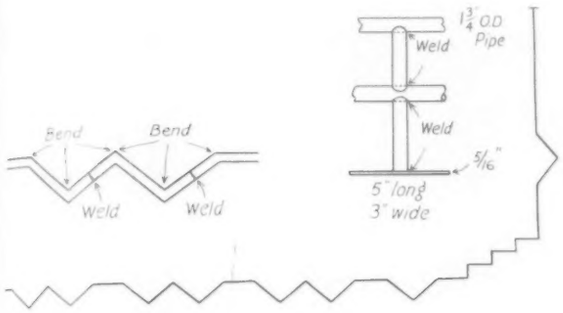
Probably the most important piece of construction work now under way in the Chicago district is that of the 1933 World's Fair, which has been given the official title of "A Century of Progress." The officials in charge of this immense project have been working steadily with definite plans ever since the first decision was made to go ahead with this event.

Welded Pipe Railing on Balcony of Administration Building.

It has been necessary to create hundreds of acres of new ground along the lake front just south of the business district of Chicago to provide space for the Exposition. Several of the important buildings have already been erected. These include the Administration Building, the Travel and Transport Building and the reconstruction of Fort Dearborn. Additional buildings are now in the process of construction.

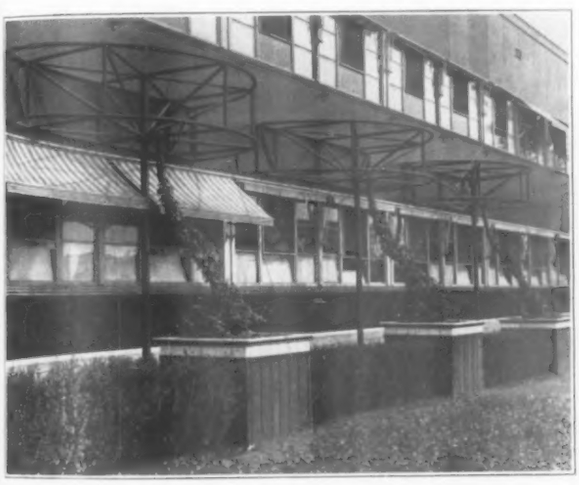
Two interesting uses of welded piping for ornamental work are found in the Administration Building. One of these is a railing around the balcony which surrounds three sides of

the trustees room. This job is the work of the Jos. Halsted Company, which is located at W. 31st Street and Spalding Avenue, Chicago. The railing is made of 1¼ in. O. D. pipe. The total length of pipe used is 184 ft. 6 in. The shape of the railing is illustrated both in the photograph and in the sketch. To obtain the desired shape in the horizontal pipes,



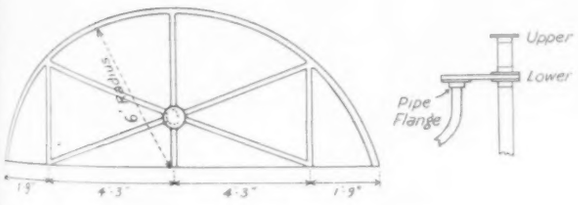
Details of Railing Construction.

sections of pipe were bent and butt welds were used to join the bent sections. In all, 48 welds were required on the horizontal pipes. The vertical members were made in two pieces, cut as shown in the diagram and welded to the horizontal pipes. The job required 54 of these uprights, with 4



Welded Vine Supports.

welds to a post. This was all done by the metallic art process, and after welding, all of the welds were ground and filed smooth.



Assembly of Pipe for Vine Supports.

To the right in the photograph is seen the steel construction work and pile driving for the Hall of Science, which is the fourth building to be erected. On an island to the left is seen the preliminary construction work for the erection of the electrical group, which is the fifth construction project.

The other photograph shows arc welded piping used in the construction of vine supports, which will add a decorative touch to the landscaping of the front of the Administration Building. Two years hence vines will completely cover these metallic frames. The welding on these supporters was done by Reuter Bros. Iron Works, 5816 S. Wood Street, Chicago. The diagram shows the general construction and also the detail of the assembly at the center. The uprights are 3½ in. pipe and the horizontal framework is 1½ in. pipe. This was all shop fabrication by the metallic arc process. Six of these frames have been made for the front of the Administration Building.

Battledeck Floor Installed in Des Moines Office Building

The Pittsburgh-Des Moines Steel Company, Des Moines, Iowa, is just completing a new three-story office building, in which the welded battledeck type of steel floor is being used. ⅛-inch plates are laid on 3-in. I-beams which are spaced on 2-foot centers, the I-beams having a span of 10 feet. The building is 50 ft. x 100 ft. Instead of using structural steel plates, they used 48x⅛-in. sheets, cut and sheared to dimension at the mill. The plates were spliced by welding over an angle bar at points other than over the girder. The welding was all done with a portable arc welder, and coated electrodes were used. Holes were punched over beams or through the edges of plates ⅝ in. in diameter and on 1 foot centers. Buckles in the plate edges were removed by welding behind a

Battledeck Floor in New Building of Pittsburgh-Des Moines Steel Company.

weighted roller. As soon as the hole was welded shut, the roller advanced and the welder peened this weld down until it was flush or below the plate level.

The general contractor placed the concrete footings; then the steel was erected and the steel floors and roof deck installed. Then the contractor came back and put up the enclosing brick work. It was not necessary for him to use any scaffold on the outside of the building for placing the brick work. This saved him considerable expense. It took about three weeks to put up the framework, rivet it and put down the floors and weld them. The finished floor will consist of ⅜-in. asphalt tile. "From all indications to date," states Mr. A. D. Little, Production Manager of the Pittsburgh-Des Moines Steel Company, "this is a very satisfactory type of construction, and we are well pleased with it."

Steel Cars Made Leakproof By Arc Welding

A new and unusual type of car construction, which utilizes the electric arc welding process to secure an absolutely leakproof construction, is now being used by the Canton Car Co., of Canton, Ohio, in the fabrication of 20 steel gondolas.

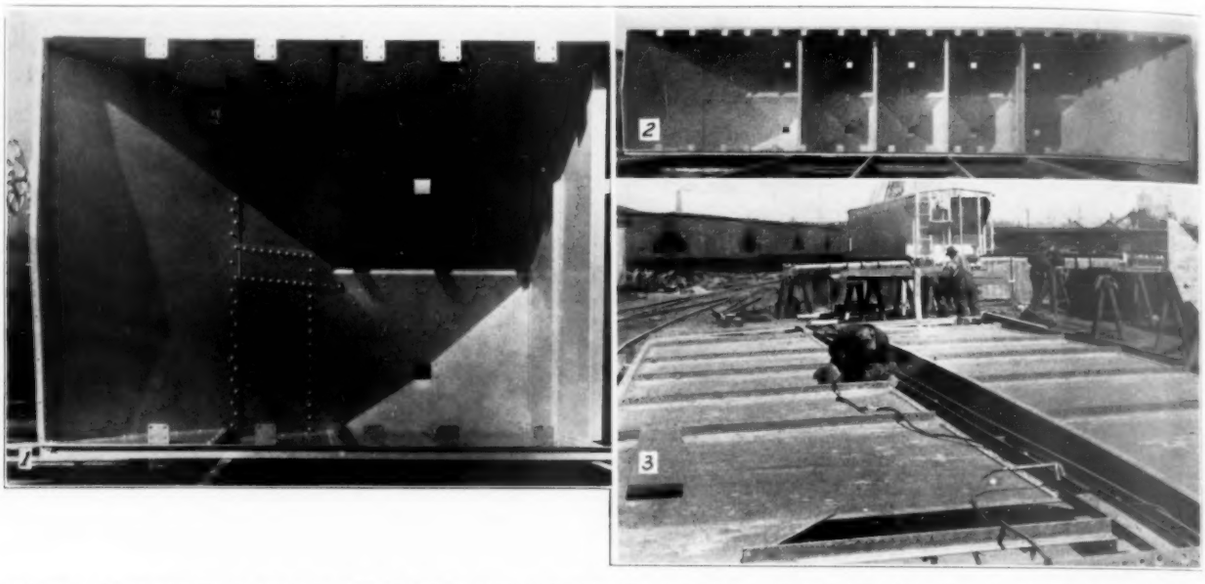


Figure 1. One Section of the Car Which Shows How Arc Welding Has Been Used to Seal the Seams. Figure 2. Entire Top View of One of the Cars. Figure 3. Operator Welding Stiffeners to Side of Car. A Complete Car Is to Be Seen in the Center Background.

These new gondolas are 44 feet long inside, 10 feet wide at the middle and weigh approximately 70,000 pounds each. They are being built for the Alcoa Ore Co., of East St. Louis, Ill., a subsidiary of the Aluminum Company of America, and will be used for the transportation of aluminum oxide from mines to the smelting plants. The cars are being built by a combination of riveted and welded construction, as shown in Figure 1, to insure an absolutely leakproof gondola.

The capacity of each car will be 3,040 cubic feet, or approximately 70 tons. The inside of the cars is divided into 10 compartments, as shown in Figure 2, each of which can be unloaded separately through a hopper at the bottom of the compartment. These hoppers are steel castings of special construction and are welded to the bottom of the compartment to further insure leakproof construction. These special precautions are prompted by the difficulty of handling aluminum oxide. The present method of transportation, in canvas-lined box cars, is being replaced due to excessive losses in hauling this substance. The owners of the new cars demand that the cars when completed show no leaks when tested two-thirds full of water.

Loading of the cars will be done through two manholes in the roof. The oxide is loaded under pressure with force enough to hurl it from one end of the car to the other.

In this new construction the cars are improved in physical qualities as well as made leakproof, by the addition of arc welding. The steel members which go to make up the design are riveted together, and the car is then fused into an integral steel unit by the electric arc. Figure 3 shows an operator at work on a side of a car fusing the angle stiffeners to the steel plate of the car side. The welding current used in the fabrication of this car was furnished by Lincoln "Stable-Arc" welders.

When completed each of these cars will conform to all recommendations of the A. R. A., the latest Rules and Requirements of the I. C. C., and the Rules of Interchange.

Up-to-Date Tank Shop Has Complete Testing Equipment

By M. L. Rogers

THERE continues to be a difference of opinion regarding the relative merits of riveting and welding in the construction of high-grade tanks. It is doubtful if any favoritism toward riveted construction exists in the minds of any tank fabricators who are thoroughly informed on the real merits of welded construction and the possibilities of applying it from the standpoint of both economy and improvement of the product. It is probable rather that the preference for riveted construction exists mostly among tank users who have not given the properly welded product a fair trial, and therefore continue to specify the riveted article.

There is probably no better way to visualize the real possibilities of welding and to understand how welding must be applied to secure all of the advantages in tank construction than to observe what is going on in a plant where tanks are made by welding procedure which is practically 100% efficient. Such a plant is that of the American Tank & Equipment Corp. at Oklahoma City, Okla. Mr. C. B. Taylor, General Superintendent, is an enthusiastic user of welding and has done splendid work in promoting the use of the process in his field under conditions which make for the greatest satisfaction on the part of tank users.

A short time ago the writer had an opportunity to visit the plant and become acquainted with the plan of operations. In the main office building there is one room which tells a great deal of the story of the success which this company has had in the use of welding. This is the laboratory which is maintained for experimental purposes. There has been installed here a collection of the most modern laboratory equipment, costing thousands of dollars and providing facilities for both

chemical and physical investigations and for making macrophotographs and microphotographs. The best way to describe it is to say that they seem to have the necessary equipment for making every possible test, and the officials of the company consider that this laboratory work, backed up by a force of first-class engineers, is responsible for the continuous advancement toward better and better results. Some of the tests which were under way at the time were really remarkable. There was time to make notes of only one. This was a 1" wide strap cut out of an electrically welded plate. The strap was about 8" long with the weld running across the center. The coupon was bent 160° and the elongation of the outer fibers was 40%. In spite of this, no checks of any kind could be seen in the weld.

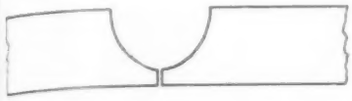


Figure 1.

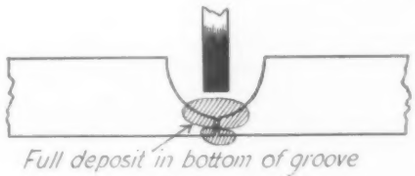


Figure 2.

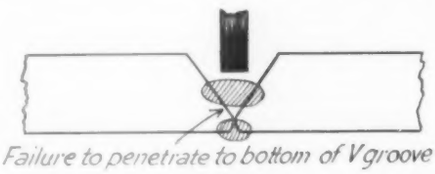


Figure 3.

On entering the tank shop, it is immediately apparent that the shop itself is designed and laid out to accommodate efficient welding practice. The machinery and equipment is so arranged that straight line production is maintained as nearly as it is possible to maintain it in manufacturing tanks and general plate fabrication work.

The steel is moved into the plant by means of a spur track. It is unloaded from the cars by overhead cranes and stacked on end in order to save space. When an order is received, the traveling overhead crane removes the necessary steel from the rack and delivers it to the layout department, from which

Figure 4. Plate Stock Ready for the Rolls and Shears.

it proceeds in a straight line through the shears, punches, plate planers, rolls, etc., until it finally reaches the fitting up department.

In this department the entire tank is tacked together and then proceeds on its way through the automatic welder, the fitting department, the annealing oven, the test rack, the paint department and finally onto the car for shipment. After the tank is once tacked together, it is kept constantly moving very much as a Ford car is handled on the production line in the assembly plant. With this systematic manufacturing method a larger producion is obtained with the same overhead than would be possible if each tank remained in one spot until it was entirely completed, as is the practice in a good many fabricating shops.

The capacity of this plant is for any type of plate welding up to 1¼" thickness, and in fact any type of plate fabrication. Practically anything which can be riveted or welded in a steel product is made here, with the exception that they do very little structural steel work.

At the time of the writer's visit, there were under construction and in stock such things as oil separators, water tanks, oil tanks, water tank towers, wagon tanks, truck tanks and a considerable number of other articles which were being made to fill special orders.

One of the most interesting parts of the shop equipment was the large annealing oven which is one of the very few annealing ovens used for this purpose and is said to be one of the largest of its kind in existence. Its dimensions are 14′x14′x80′. Vessels which have been electric welded go through this oven. After being placed in the oven, the welded article is brought to a heat which is sufficient to remove all residual stresses caused by welding. This is called stress reliquing, and makes for a more uniform strength and prepares the structure to undergo more efficiently any working stresses with which it may come in contact after being put into service.

Although it was mentioned above that this company has

Figure 5. The Welding Bay in Operation.

not done a great deal of structural steel welding for other concerns, it is interesting to note that this shop building is an all-welded structure—not a single rivet being used in its construction. It is a 140′x260′ building.

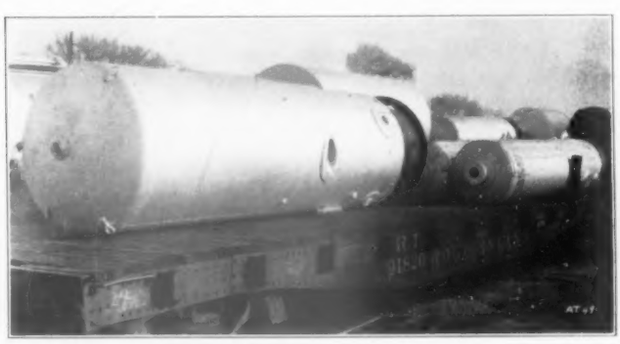


Figure 6. Carloads of Welded Tanks Leaving the Plant of the American Tank & Equipment Corp.

Over 25% of the men employed in this plant are welders. Ordinarily, the entire force is 170 men. 40 of these are electric welders and 6 oxy-acetylene welders. This includes one operator who takes care of a large automatic arc welding machine which it is estimated turns out a volume of work equivalent to that of six manual operators. It is equipped to make two welds at one operation. This particular piece of automatic equipment is thought to be the largest machine of this kind in operation in the southwest. It is advantageous not only from the standpoint of faster production, but

also from the standpoint of uniformity of welds. In preparing the plate edges for the automatic machine, the planer is arranged so as to avoid producing the conventional perfect V, but instead a more rounding groove, as indicated in Figure 1. With this method of preparation, the arc deposit is more apt to be made with full penetration to the bottom edge of the plate as indicated in Figure 2. In thick plate the preparation in the form of a perfect V is more apt to result in a lack of penetration, as indicated in Figure 3.

Another interesting observation made here was that there is little favor shown for the method of dishing out a tank head, flanging it, then setting it inside of the shell to be welded with a fillet weld. Instead of doing this, the method preferred is to dish and flange the head so that it is the same diameter as the shell; set it up against the shell flush, instead of setting it inside, and making a butt joint instead of a lap weld.

In this plant about 95% of the output is welded, and only about 5% riveted. The American Tank & Equipment Corp. has been operating for many years in the southwest territory. They were among the pioneers in this country in the use of welding. They always keep their operations under careful control and endeavor to take advantage of every up-to-date improvement in procedure. Working conditions in the plant are of the best, with the surroundings as clean and pleasant as can be found in any plate fabricating shop in the country.

Record Breaking Convention Planned by Acetylene Group

Due to the success of the program committee of the International Acetylene Association in obtaining for its next convention a collection of papers on gas welding and cutting, which are of exceptional interest and value, it is expected that the attendance at the November meeting will break all previous records by a large margin. A great deal of care has been exercised in preparing the program so as to obtain speakers who are able to furnish information based on long and successful experience in their particular fields. These papers have been grouped so as to furnish a continuity of interest in each of the technical sessions; and the sessions themselves are built around some of the most important phases of the oxy-acetylene industry.

Of particular interest to the entire oxy-acetylene industry is a session devoted to inspection methods and other considerations involved in safe guarding the quality of oxy-acetylene welds. Because of the importance of this subject to all industries, which use the process, and because there are many men who could profit by the discussions and who are not able to leave their work during business hours, arrangements have been made to hold this session on the evening of the opening day, Wednesday, November 11th. This makes it possible for a much larger number to attend this particular session and arrangements will be made to secure a meeting room large enough to accommodate a maximum attendance which is expected. The subject of Plant Training Methods will be handled by the welding superintendent of one of the largest plants in the Chicago district. The theme will be further developed by an unusually thorough presentation of the subject of Inspecting Welds. Both motion pictures and actual demonstrations will be utilized to supplement papers on this important subject. The committee has called upon some of the best talent of the industry to assist in this evening's program and have arranged it so that it will be of great practical value to all users of the welding torch regardless of nature of the work that they do or the volume of welding in which they are interested.

Another session which is certainly of great importance at the present time is on the general subject of pipe welding. Emphasis will be placed on recent research in this branch of the industry and on the solution of problems which have been troublesome in certain applications. Special sessions will also be devoted to the transportation industry and the chemical industry. There is also one session on educational phases of the industry, which will be of particular value to manufacturers of equipment and materials, supervisors in large industrial plants where plant training methods are needed, and instructors in trade, technical, vocational and engineering schools. It has been noticed that in many previous conventions there have been inquiries regarding training methods and probably the best description of this educational session is that it has been arranged to furnish complete and helpful answers to all of these questions which have been raised at previous conventions.

The convention will be held in the Congress Hotel, Chicago, on November 11, 12, and 13. This location is within easy driving distance of the principal industrial centers of Illinois, Indiana, Wisconsin, Michigan and Ohio and all sessions being open to the public, the Association has issued a cordial invitation to all persons in that district to attend as many of the sessions as possible. Advance copies of the program are being prepared for distribution and the publishers of *The Welding Engineer* have made arrangements to secure an adequate supply of these so that they can be furnished to any readers who desire to obtain them, and thus be able to plan their visit so as to be present for such portions of the program in which they are most interested.

24-Inch Steam Line Fabricated with Shielded Arc Process

No chill bands or backing-up rings were used for arc welding a 20- and 24-inch steam pipe line just completed in St. Louis, Missouri. This innovation in pipe line practice has been used on several small petroleum transmission lines but its application to the welding of large diameter pipe is notable.

The line is 6000 feet long and runs from the Ashley Street Power Station of the Union Electric and Power Company to a distribution point in a district heating system in the heart of the business area. It will be operated at 200 lbs. pressure and 150 degrees super heat. A general view of the line is shown in Figure 1.

Procedure on this line was practically the same as that used on natural gas transmission lines. The 20-foot sections of plain butt end pipe beveled at 30 degrees were lined up on rollers and fused together with two beads of weld metal deposited by the Lincoln Shielded Arc process using ¼-inch and 5/16-inch Fleetweld electrode. The time consumed for placing and cleaning the stringer and finish beads at each joint was 24 minutes on the 20-inch pipe. Somewhat more time was required to line up the pipe than would have been necessary had a backing-up ring been used.

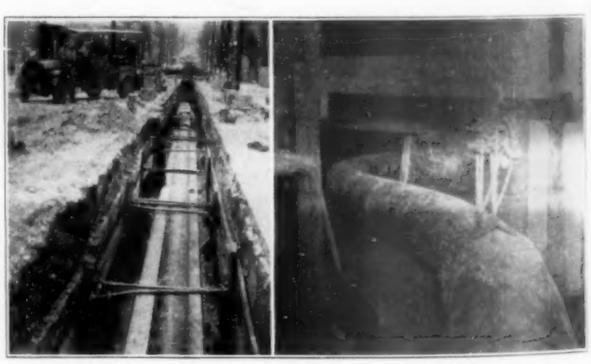


Figure 1 (Left). The Welded Line in the Ditch. Figure 2 (Right). An Offset Bend in the Twenty-four Inch Line.

Where possible the sections consisted of eight lengths of pipe and these sections were tied together with three to five beads of weld metal in the ditch. A view of an offset in the line after welding is shown in Figure 2.

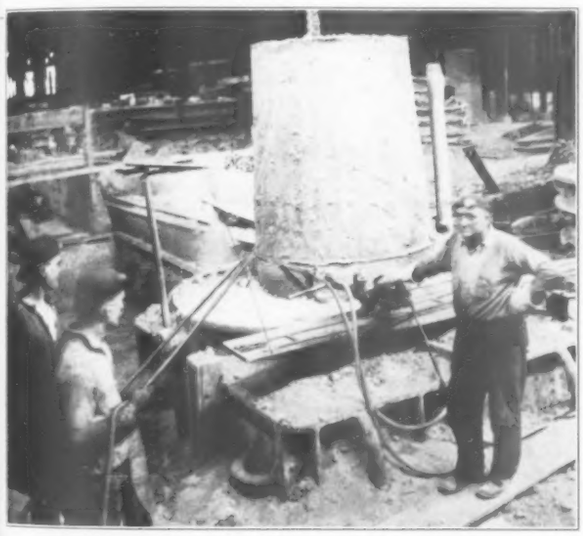
The pipe used was manufactured by the National Tube Company in ½- and ⅝-inch wall thicknesses. The welding was done by the Northeastern Piping and Construction Company with motor truck mounted gasoline engine driven Lincoln "Stable Arc" welders.

Hints for the Welder

WHEN YOU FIND a new way to do a hard job, or finish a particularly interesting weld, can you describe how the work was done? . . . . . Have you learned some little stunt every welder ought to know? . . . . . Write to us about these things . . . . . This department helps you welders to help each other. Write up your ideas any old way and just make rough pencil sketches . . . . We'll fix them up for publication.

Extra Heavy Cast Steel Riser Cutting

A STEEL foundry in Pennsylvania was confronted with the problem of removing solid cast steel risers, 54 and 66 inches in diameter from large hydraulic press cylinders. As oxy-acetylene cutting was the logical process to employ, the Air Reduction Sales Co., Applied Engineering Department, was consulted and Supervisor A. H. Yoch, of the Philadelphia District, called and devised a set-up which performed the work in a most satisfactory manner.



Radiagraph and Oxygen Lance Set Up to Remove Riser.

The accompanying photograph shows a 54-inch diameter riser about to be cut off, with apparatus and operators in position. The first cuts were made at a distance of 12 inches from the finish line of castings, with castings heated to between 700 and 800 degrees F. to prevent checks. Later cuts were made at a distance of 7 inches from the finish line of castings, with castings heated to between 300 and 400 degrees F. The risers were stripped before starting cuts, as shown.

A special attachment was needed to mount the machine torch on a Radiagraph in the position illustrated, with provision for a horizontal movement of torch of almost one-half the riser diameter. To assist the operator, a high pressure oxygen gauge was fitted at the torch. A No. 10 tip was used in the machine torch.

Two oxygen lances, made of ¼-inch gas pipe, 12 feet in length, were employed to assist the Radiagraph.

The cuts were started by the Radiagraph, using 120 pounds oxygen and 15 pounds acetylene pressure, operated at a cutting speed of 1½ inches per minute. With the Radiagraph alone, it was found possible to penetrate the edge of risers to a point where the thickness of metal, in line of cutting jet was 18 to 20 inches for first cuts, and 28 to 32 inches for later cuts.

Then the two oxygen lances were put into service, operating at 120 pounds oxygen pressure. The first lance was made to follow closely behind the machine torch, to carry the cut through the remainder of the thickness left by the machine torch while the second lance was employed in keeping open the back of the cut, or far side from machine torch. This second lance was found necessary to prevent slag and hot metal from puddling in kerf and burning its way into casting. As the first lance burned away and became too short for safe use, it was discarded and second lance substituted. The operator of the second lance received a new one from a helper (not shown) who then renewed the discarded lance in readiness to repeat the rotation of lances.

In cutting a 54-inch diameter riser, an average of 5250 cubic feet of oxygen and 290 cubic feet of acetylene was consumed. For a 66-inch diameter riser, an average of 6160 cubic feet oxygen and 400 cubic feet acetylene was required. Cutting time per riser was from 45 to 60 minutes, and lances consumed per riser were from 18 to 20.

Practical Short Cuts in Field Work

The two photographs shown in the accompanying illustrations which are furnished through the courtesy of the Chicago Bridge & Iron Works, Chicago, Ill., tell the story of a couple of interesting short cuts in field operations such as are required in the extensive tank construction work which is

Left: Light One-Man Scaffold Used in Closing Bolt Holes.
Right: Ingenious Rig for Air Hammer.

common to the oil fields. The first one shows a welder on a scaffolding placed against the side of a large riveted tank shell. This fellow's job is to close up the bolt holes which were made for the preliminary assembly. The advantage of welding for this job is that only one man is required to do the work, and the scaffolding is a light affair easily moved to any location on the outside of the tank and is only required

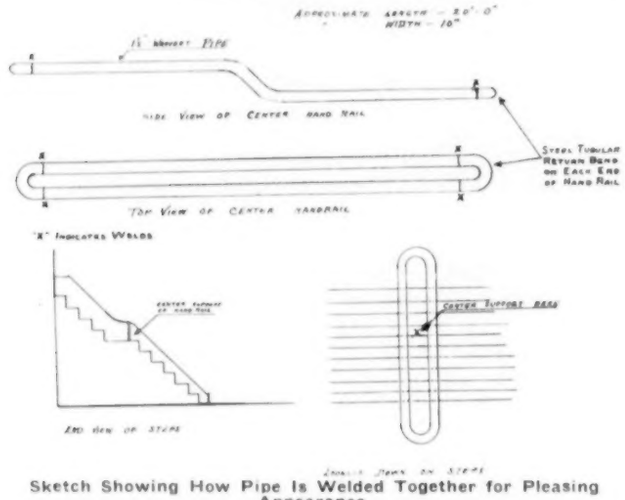
on one side. This is quite a contrast to the amount of material and labor required for scaffolding on both sides and the crew which would be necessary if these holes were closed by driving in rivets.

The second illustration shows how an air hammer has been rigged up by means of a few pieces of lumber to make it stationary. This tool is in considerable demand on the job for the repair of numerous other tools which get rough handling when the tank plates are being assembled and put into position. In order to do the same work it is often customary to have a portable forge with a blacksmith and helper, but this ingenious device makes it possible for one man to do a great deal more work in much less time.

Advantages of Welded Piping For Hand Rails

By W. H. Wilson

On the outside steps of one of the public buildings now under construction in Chicago, there is a hand rail fabricated of 1½ in. steel pipe. While this is not an unusual application of welding, there are some interesting features involved in the construction of this particular railing. It consists of two sections of 1½ in. pipe connected at each end with tubular steel return bends, making a continuous piece of pipe with a


Approximate Length = 8'-0"
Width = 10"
1½" Standard Pipe
Side View of Center Hand Rail
Steel Tubular Return Bend on Each End of Hand Rail
Top View of Center Handrail
"X" Indicates Welds
Center Support Base
End View of Steps

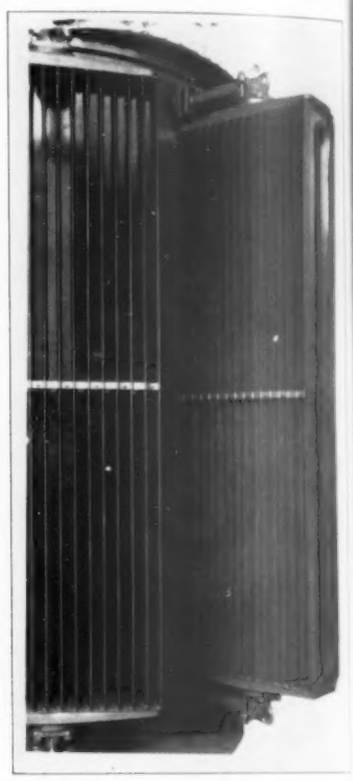
Sketch Showing How Pipe Is Welded Together for Pleasing Appearance.

hair pin loop at each end. If this hand rail had been assembled by using screwed pipe and fittings, it would have been necessary to use two couplings with right and left hand threads on at least one end of the pipe railing. The joints would have to be made up carefully in order that the pipe would remain of equal length and not be strained and thrown out of line. Or, either of the couplings would have to be drilled out, slipped over and then secured by pins. In either case the couplings would show and spoil the neat appearance of the completed job. While using standard pipe and return bends and the welding process, it is possible to construct a rail of this shape and keep the pipes parallel and permanently secured together. A little grinding will make the outside surface smooth and free from projections. The unusual design, which gives this rail a particularly neat and pleasing appearance, is best shown by reference to the accompanying diagram.

Use Resistance Seam Welds in Making "Blown-Up" Radiators

Two long strips of 1/20-inch thick steel, welded together around the edges and then "blown-up" by air pressure, is the ingenious way Westinghouse Electric & Mfg. Company makes transformer radiators.

In the manufacture, a pair of flat steel sheets cut to the right shape are placed back to back and welded air-tight around the rim and then spot-welded down the center for strength before being deformed in any way. Automatic resistance seam welders do this work. This flat air tight metal bag is then placed between the retaining walls of a jig, and 90 lbs. per sq. inch air pressure (corresponding to 500 normal working pressure) inflates the steel shell to produce



Rugged Transformer Radiators Made by Resistance Welding Light Steel Sheets.

a light, rugged, cooling section. After welding, inflating and forming, several cooling sections are grouped into a common header to form the radiator.

Great care is taken that the welds do not leak. The inflating air is a severe test itself, but the most trying ordeal follows the complete assembly when the radiator is stood upright and 80°C oil at 15 lbs. per sq. inch pressure is circulated through it for two hours.

All welded surfaces are on the outside, where they can easily be inspected; parts are quickly cleaned and painted, and there are no places on which water can stand.

All-Welded Overhead Irrigation System

Much has been written of welded pipe lines of different kinds which are placed underground, but little mention has been made of extensive developments which have recently been made in overhead pipe line systems. This development, while not entirely new, is growing in importance and popularity especially in sections of Southern California's citrus fruit and avocado districts. These systems of overhead piping are used for the irrigation of large orchards and commercial groves of the different kinds of fruit trees in these localities. Installation of these pipe systems is almost exclusively by welding.

Photographs of one of these systems accompany this article and show methods of installing. These views were made on the large fruit ranch recently purchased and now being developed by the celebrated movie star, Douglas Fairbanks. The ranch is located near the well-known "Rancho Santa Fe," not far distant from the beach city of Oceanside, and is

composed of several hundred acres which are being set to oranges, lemons, avocados, and other fruit adapted to this section of Southern California.

The welding of these lines is all by oxy-acetylene, and has provided considerable work for local contractors in this line of work. View No. 1 shows a view of one section of the

Figure 1. Overhead Sprinkler System in a Newly Set Avocado Grove.

system installed over a large newly-set grove of avocado trees. Hundreds of miles of welded pipe with welded fittings, etc., are being utilized in this method of irrigation. The application of the water to the soil is by means of a whirling spigot arrangement which functions by the force of the water pressure in the pipe much as by the ordinary lawn sprinkling devices. The water is thus distributed over the area by these whirling devices placed at frequent and regular intervals along the top of the pipe. One of these can be seen in Figure 1. A six-inch main feed line supplying water to one section of a system is seen in Figure 2, which is of a very young orchard.

The development of this method of irrigating is the outgrowth of extensive experimenting, and is believed by men of high authority in horticulture to be the most effective process of watering trees artificially ever used. Coming in the form of rain, it provides the nearest thing to natural rainfall and is claimed to be most beneficial probably by reason of the fact that much of the moisture supply of fruit

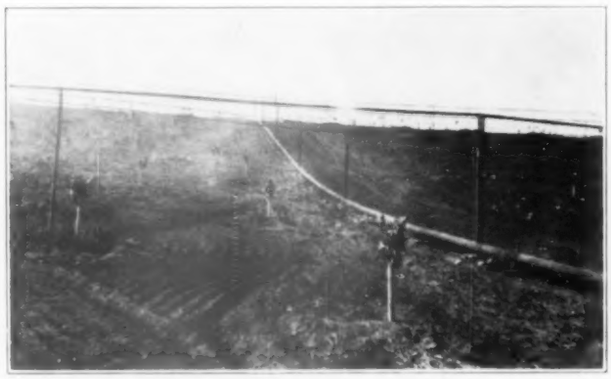


Figure 2. The System Is Supplied with Water by a Six-Inch Feed Line.

trees in this country is taken from the air during the wet seasons through the leaves of the trees. This development has also been beneficial in providing work for large numbers of welders in this section, as welding is used wherever possible in installing these pipe irrigating systems.

Building a Job Welding Business

By W. Irving Brockson

VI—Direct Mail Advertising

PART III. Kinds of Circulars to Send

THE actual physical form which your circulars are to take is governed by what your message is, what you want your prospect to do when he gets it, the amount of money allotted to the effort, etc. As previously suggested, the amount of money spent for direct mail does not have to be a fabulously large sum. Success is more dependent upon having a good list of prospects, a good business-like sales message to present, the correct personal follow up and other factors than it does upon spending a large amount of money for the individual pieces mailed.

Personal Letters. Letters have been called the highest form of advertising, primarily because they convey a message from one person to another. When they are actually typewritten (or typed by the automatic typewriter in quantities), filled in with the prospects' names at the top, signed in pen and mailed as first class postage, they will be read in the vast majority of cases. The percentage of such letters which "kiss the waste basket" is small indeed.

Letters can be changed and adapted with ease to suit the needs of the occasion and to talk the language of the prospect. If you have 10 foundries in your territory, you can write them all a letter dealing with reclaiming faulty castings with welding. If you have 13 large garages, you can send them a letter in the winter about revamping cracked cylinder heads. If you are in a farming district, you can write to "the horny handed man of the soil" about repairing broken plows, harrows and other machinery. In each case you can interest the prospect with a letter which "talks up his own alley," discusses a subject which is of vital concern to him.

Form Letters Not Personally Addressed. Many firms make very effective use of letters which are multigraphed, mimeographed or printed on their own letterheads, but which do not bear the name of any person or company in the upper left area where the salutation goes on a personal letter. Such partake more of the nature of a circular than a letter and must rely on a message "with a punch," headlines, subheadings, a second color, or other mechanical devices for their pulling power. Such letters are ordinarily used where large lists running into the thousands are circularized and are not so frequently used on the lists of less than a thousand.

Folders and "Broadsides." These terms are used to cover a "multitude of sins" in the way of printed circulars ranging in size from midget specialties to huge affairs requiring folding before they would fit into a "bushel measure." Speaking very generally, a folder is used to mail in an envelope either alone or with other mail, whereas a broadside is a "self mailing" piece requiring no envelope. The number of folds and the methods of folding in both cases seem to be limited only by the ingenuity of the designer.

One of the principal values of this class of direct mail lies

in its announcement effect; sometimes it is known as "flash stuff" intended to get attention by its very size, use of color, illustrations, etc., and get over its message quickly. Usually the person receiving this class of material cannot discard it without getting some impression; e.g. the name of the product, name of the firm, and a general idea of "what it's all about."

By giving a little thought to the matter, the job shop, sometimes with the help of a good printer or letter shop, can design a broadside or folder of two or three folds, very modest in cost, which will (a) announce the establishment of the business; (b) tell briefly, in summarized fashion, the main kinds of work done; (c) stress a successful welding job having wide application; (d) or similar information.

Mailing Cards. Mailing cards range in size from the regular government postal card up to six by ten inches. Mostly, they are made up of a single, unfolded cardboard, but occasionally there are two folds held together by stickers or stamps.

Their value and field of use are somewhat comparable to the broadside, only their message is usually brief and they are not so "ambitious." One point to recommend them is their low cost.

It is rarely advisable to send out one postal card to the names on your mailing list and "let it go at that." To be effective, a series of three or more cards, mailed at one or two week intervals should be used.

Booklets are good will builders; they don't usually do much in the way of getting action by producing immediate inquiries. As opposed to "flash stuff," they are designed to present a more lengthy story than is put into a letter, a broadside or postal card. They make an "informational" appeal, that is, they are put up so as to make the recipient want to read them to get the facts they contain.

The welding shop can well use a brief booklet to set forth certain major subjects which he wants to get over to his list of prospects, facts which his knowledge of the territory and of his prospects points out should be presented. For example, the advantages of welding over riveting in building construction, the general savings which can be made with welding, etc.

Using Manufacturers' Helps. Every welding shop manager should take full but discriminating advantage of the many printed helps which are offered by the firms from which he buys his welding rods, his machinery and supplies. A great many of these manufacturers and jobbers are glad to furnish the welding shop with reprints of advertising, folders, envelope enclosures, blotters, novelties, etc. Frequently the name of the manufacturer does not appear on these helps, only the shop which distributes them. In other cases the manufacturer will put his name on the printed material, but will cheerfully add the name of the distributing shop. To be sure, the shop owner should try to use such material as will bring business to his shop and avoid the use of that which may send orders elsewhere. With this precaution, the use of manufacturers' literature is a very effective and economical procedure. Such literature is usually far more voluminous, colorful and appealing than the job shop can afford to have produced. Moreover, the only expense involved is the envelopes, the postage, and the mechanical operations of addressing, enclosing and mailing.

Do the Job Well

Even though direct mail advertising is inexpensive, flexible, adaptable to the welding business and a powerful aid in building sales, it is no job to leave to the "delivery boy." Rather, if it is to be successful, its planning and execution require very careful and mature thought. The very fact that direct mail is so powerful a sales tool causes its extensive use and, consequently, your circulars will be in competition with dozens of others—not necessarily in the same line of business—for the attention of the buyer. If they are obviously sloppy and the work of an amateur, they will suffer by comparison.

Keeping It Up

If just one circular is well prepared, sent to logical prospects and the resultant inquiries properly followed up by personal calls, that *one circular* has a good chance to show a profit. However, it is unwise to approach the subject of direct mail advertising with the idea of sending out two or three "fliers" and then stopping. The use of this form of sales promotion should be looked upon as an essential part of a sales program which is followed through indefinitely just the same as the sign is kept on the outside of the shop and the name in the telephone book.

Further Study of Mail Advertising

Of necessity, in these articles it has been possible to outline only some of the more important phases of mail advertising. From this point, a good second step is to study the mail which you receive and try to decide what features of each piece make it effective or ineffective. If you are interested, a third step could well be to subscribe for a good magazine, costing a nominal sum of a couple of dollars a year, devoted entirely to the production of sales building literature to send through the mails. Furthermore, if one is studiously inclined, he can find several good books on the subject. *The Welding Engineer* will be glad to suggest the best sources of information if you wish to go further in the question.

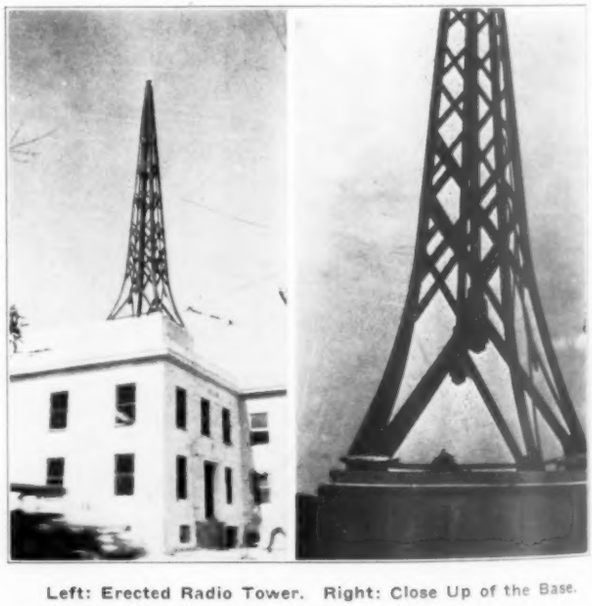
Help From Your Printer

One of the sane things for a welding shop to do before spending much money on direct mail advertising is to confer with one or more good letter shops, direct mail service organizations or printers who are experienced in producing advertising printing. Don't go to any 'hammer and tongs" organization, but seek out the good ones. Preliminary talks will not cost you a penny, and before you make any arrangements requiring the outlay of money, you can have a definite agreement as to what is to be done and what the cost will be.

Steel Radio Towers of Welded Construction

By F. H. Marsh

Two all-welded steel towers were recently built by the Paterson Steel Company of Tulsa, Okla., for the broadcasting system of the Central Police Station at Tulsa. These towers



Left: Erected Radio Tower. Right: Close Up of the Base.

are approximately 40 ft. high. The legs are 4 in. x 4 in. x 1½ in. angles and the sides are made up of welded plates. These towers were welded completely in the shop of the Paterson Steel Company and were erected with a gin pole after transporting to the building. The C. M. Pritchard Engineering Company prepared the structural drawings. The accompanying illustrations show the complete towers after erection and a close-up of the base of one of them.

Report of A. W. S. Committee on Structural Welding

There has been published recently a report constituting a complete record of the activities to date of the Structural Steel Welding Committee of the American Bureau of Welding—a committee organized in 1926 for the purpose of "obtaining reliable information upon which to base safe unit working stresses in the designing of welded structures."

After reviewing all of the test data in the literature available at that time, the committee concluded that a comprehensive series of tests should be made before final recommendations were promulgated.

An investigation was therefore undertaken, the principal objects of which, after some modifications during the progress of the work, were the determinations of:

1. Safe design values under static loading for various types of fusion welded joints as commercially welded in structural steel fabricating shops.
2. The degree of unformity of the strength of welded joints that may be expected from such shops throughout the country.

In order that the results of the investigation would be thoroughly representative of commercial practice, a large number of shops were invited to participate. To insure the maximum uniformity of procedure in the conduct of the tests, comprehensive instructions were prepared covering all details from the selection of the welders to the preparation of test reports by the cooperating laboratories.

The final program, as carried out and reported herein, included the welding and testing of 1,098 specimens in connection with the qualification of the welders and 1,395 specimens in connection with the investigation proper—the latter involving 55 elemental forms of joint in 169 sizes.

The participants in the investigation included three steel mills, 39 fabricating shops, 61 welders, 18 inspectors, and 24 testing laboratories. The work was distributed over the central and eastern portions of the United States. A Canadian laboratory provided pilot or preliminary information based on the testing of 342 specimens welded in three Canadian shops. About five years have been spent on the entire investigation.

The final conclusions of the committee with respect to its two principal objects of investigation are:

1. The following permissible unit stresses, in kips (thousands of pounds) per sq. in. of weld throat, specified in the American Welding Society's "Code for Fusion Welding and Gas Cutting in Building Construction":

   Shear 11.3
   Tension 13.0
   Compression 15.0

   are safe and reasonable, and are indorsed, provided the welder has been qualified and provision has been made for bending stresses that may be introduced due to eccentricity.
2. In commercial practice a welded joint may be expected to have a strength within 12 per cent of a general average for that type of joint, provided the welder has attained the stated qualifications.

The important requirement in that Code with reference to making adequate provision for bending stresses due to eccentricity can be met in a practical manner by a division of joints into two classes—those having negligible and those having considerable eccentricity. Simple characteristics are given in this report whereby a proper classification may be made.

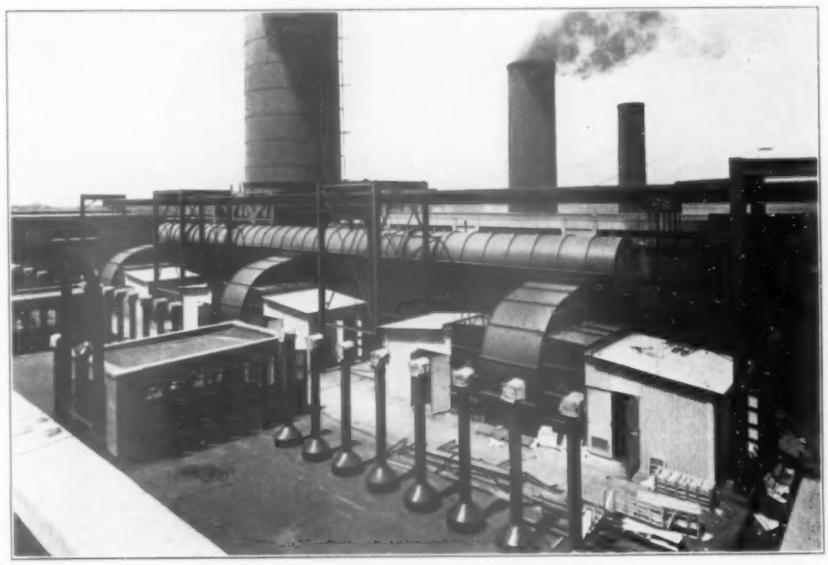
This report points out that the committee's conclusions are necessarily based on the behavior of the particular specimens investigated, and with a view to extending the scope of its conclusions a number of desirable fields for further research are recommended.

The report is a handsome octavo volume of 208 pages printed on excellent paper and bound in a serviceable cover. The subject matter is divided into ten sections and cross reference is facilitated by the Dewey decimal index system. The committee's expressed aim for a high degree of legibility in tabular and charted matter has been well achieved in the 54 cuts and 18 tables which illustrate the report. A table of contents and a comprehensive alphabetical index add to the usefulness of the report.

Four Hundred Tons of Plate in This All Welded Job

By R. E. Edwards

On April 15th of this year the James G. Heggie Sons Company of Joliet, Ill., started the erection of the breeching, fans and air ducts for a power house in the Chicago district. The accompanying photograph shows the installation after all of the work was completed. This was an all welded job which required in the neighborhood of 400 tons of plate work. The plate was fabricated as far as possible in the shop, assembled into position by bolts, and then entirely field welded. It was estimated that there are about 150,000 feet of welding on this job, which kept eight machines busy from the time it started until August 31st. We were working five days a week and eight hours per day. Over half of this work was overhead welding. The working crew required was an average of 25 boiler makers and eight welders. The material was mostly ¼" plate, and the breeching was 190' long. For the field assembly, we used a patent bolt with a buttonhead on the outside and a nut on the inside, which made that part of the work look like a riveted job. All of the seams were welded on the inside so as to make the breeching absolutely air-tight, and before being put into operation, it was tested at 12 lbs. pressure.



Eight Welding Machines Were Kept Busy Laying Down 150,000 Feet of Weld Bead in This Power House Project.

New G-E School Teaches Welded Building Design

The General Electric Company has announced the opening at Schenectady of a school of welding design to teach engineers, architects, draftsmen, etc., both in and out of its employ, methods of designing welded buildings.

There is no charge for instruction in the course, which requires approximately four weeks for completion. It is a flexible one and can be adjusted to suit each individual. The course requires that the applicant be an engineer, or have some training in structural design or some experience in the design

of riveted structures. It is then only necessary for him to learn the difference between the application of welding and riveting to steel frames.

The subject is approached from a scientific point of view based on studies and tests by the General Electric Company over a period of years in welding work, particularly in the construction of its own factory buildings. The following design problems are now being studied: typical Pratt truss; typical Warren truss; typical Fink truss; plate girder with concentrated and uniform loads; plate girder with concentrated moving loads; beam and girder connections involving various forms of brackets; column connections including base plates and miscellaneous frames as desired by the students. In addition, there are included special features within the limits of frame structures.

Purdue Conference to be Held in December

Word has been received that the annual welding conference sponsored by Purdue University, Lafayette, Indiana, will be held this year on December 10 and 11. Tentative plans provide for the usual combination of lectures and demonstrations. It is expected that more complete details regarding the program will be available in a few weeks.

Supply Dealer Uses Air Service To Get Best Out of Time

A. H. Friese, president of the Welding Engineering Company, Milwaukee, Wisconsin, is a strong believer in using business time to the best possible advantage when business is as hard to get as it is today. Accordingly, he takes advantage of the fast air service to reduce the amount of idle time on long trips. On one of his recent flying trips he left

Mr. Friese Loses No Time When He Makes Business Trips

Milwaukee late Monday afternoon, arrived in Detroit in time to hold two interviews before taking the midnight train to Niagara Falls. On Tuesday he was able to spend several hours at Niagara Falls and a few hours at Buffalo, leaving Buffalo late in the afternoon by plane for New York City in time to keep two more important appointments for that evening. This allowed spending the forenoon of Wednesday in Newark and the afternoon in New York City, leaving by a late afternoon train for Philadelphia for additional appointments on Wednesday evening. Thursday was spent in Philadelphia and Friday morning in Pittsburgh. The noon plane from Pittsburgh landed Mr. Friese in Cleveland in time to keep an appointment made in advance. Another plane trip was made to Detroit in time to transact business that evening and a midnight train set him down in Grand Rapids the next morning. The trip from Grand Rapids to Muskegon was made by plane and another plane trip from Muskegon to Milwaukee landed him back where he started from Saturday afternoon at 5 o'clock.

This program was a long way from being a leisurely trip, but by being carefully planned in advance, it made possible a considerable coverage for six business days.

St. Louis Welding Society Offers "Metallurgy of Welding"

It has recently been announced by the St. Louis Welding Society that they will hold an evening course on the "Metallurgy of Welding" which has been arranged with the assistance of E. H. Seger of the Department of Mechanical Engineering of Washington University and E. C. Meinholtz, assistant chief of tests, Missouri Pacific Railroad. The class is scheduled to meet once a week on Monday from 7:30 to 9:30. No charge is being made to members of the St. Louis Welding Society.

The following is a brief outline of the course:

1. Constituents and grain structure of ferrous and non-ferrous metals. (Illustrated by photomicrographs).
2. Composition of welding wire.
3. Effect of welding on grain structure, strength and hardness of metals.
4. Weldability of metals. Stine equilibrium chart.
5. Consideration of expansion and contraction of welded sections.
6. Physical test of welded sections, which will include an explanation of the terms used in testing and an outline of procedures for test for strength and hardness of welded sections.

Steel Orders Increase in Northwest

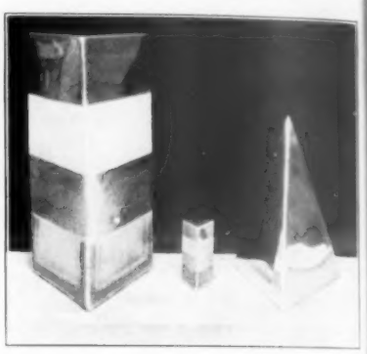
Indicating an upward trend in the steel industry in Oregon, the Steel Tank & Pipe Company has received enough orders during the later part of September to keep it busy for the next five months, according to Thomas Hanning, president of the company. The orders will necessitate the addition of approximately 100 skilled mechanics to the company's payroll.

The company has the contract to build the new oil terminal for the Fletcher Oil Company at Vancouver, Wash., a unit costing approximately $20,000. It also has the contract to build 14 miles of high-pressure steel pipe for the Mountain Lake Water Company at Bothel, Wash. This will cost $90,000.

The company will endeavor to fit the six-hour day into its scheme of production, in order to furnish employment to as many men as possible.

Welding of Special Alloys Shown at Boston Show

One of the exhibits at the National Metal Exposition, held in Boston last month, which attracted considerable attention of those interested in welding, although it was not located in the welding section of the Metal Exposition, was that of the Crucible Steel Company of America, manufacturers of Rezistal chrome nickel steels. One corner of the booth was set aside for an operating exhibit of welding of Rezistal sheets. Then there were displayed on the table a variety of welded samples, including three pieces shown in the accompanying illustration. These pieces were made up to show the practicability of making



These Specimens Indicate What Can Be Done in Fabricating Rezistal by Welding.

an air-tight and water-tight weld in this material, and also that welding can be used regardless of the type of finish which is wanted. All three of the articles shown in the picture were half-filled with water before the welding was completed. These pieces stirred up much favorable comment because of their nice appearance and freedom from any indication of warpage after they were finished.

It will be noted that the large sample shows clearly four different kinds of finish. One of these is the annealed and pickled condition showing the original weld. Next to it is a finish known as the Standard No. 4 Finish. The third part is sand blasted, and the fourth is polished and buffed, giving a mirror-like appearance. Each type of finish shown takes 4 in. of space on the large prism and 1 in. each on the smaller.

These two specimens were fabricated from the alloy known as Rezistal KA 2 taken from regular mill stock and oxy-acetylene welded, using as filler rod strips of the same material. The larger of the two prisms stands 16 in. high by 8 in. at the base of each triangle, and the smaller of the two is 4 in. high and 2 in. at the base.

The pyramid shown was fabricated to show that it is possible to weld intricate shapes by the metallic arc process and that vertical welds can be made with comparatively little difficulty. This specimen was fabricated from four triangles cut from 12 gauge Rezistal KA 2 sheets. The base is an 8 in. equilateral triangle and the other three triangles measure 8 in. at the base and 10 in. along the legs.

Boiler Makers Float Features Welding Processes

In a Labor Day Parade, which was held in Atlanta, Ga., last month, the welding processes were strongly featured in a float which represented the Atlanta Local of the International Brotherhood of Boilermakers and Helpers of America. Since welding plays such a large part of the construction and maintenance of boilers, the Lamar

The General Public Gained an Idea of What Welding Does for Them From This Float.

Welding Company of 63 N. Harris Street, Atlanta, Ga., furnished a truck containing a portable electric welding outfit and an oxy-acetylene welding equipment. Mr. Seagraves, proprietor of the company arranged for two of his welders to accompany the truck and do actual demonstrating of both processes throughout the progress of the parade. He also arranged for two old time boilermakers to add some atmosphere to the exhibit by hammering on a small boiler in the peculiar rhythm of the boilermakers. The parade itself was one of the longest in the history of the city, and a great deal of enthusiasm was noticed. Acknowledgment is made to R. G. Wilson, District Sales Manager of the Burdett Oxygen Company, Atlanta, Ga., for his courtesy in supplying photographs and information.

Texas Concern Offers Improved Method of Welding Storage Tanks

Introduction has recently been made by the Wyatt Metal & Boiler Works, of Dallas, Texas, of a new method of welding construction for steel storage tanks, in which bolts, rivets, or punching of the plates for fitting-up purposes has been eliminated. The steel plates are held firmly in position while at the same time the seams are being properly spaced through the use of wedge pins and clips on which patents are pending. Either a welded lap joint or a welded butt strap joint is used; the welding specifications and the type and design of the joint depending upon the efficiency required and the thickness of the shell plates.

Under this welding method there is no limitation as to the size of tanks which can be built. The Wyatt Metal & Boiler Works has under construction tanks with a total storage capacity of 250,000 barrels, including a 55,000 and one 80,000-barrel tank. The company has just completed a total of 58 tanks aggregating 340,000 barrels.

The efficiency of the welded joint and the lower shop and field erection costs are said to make it possible to obtain a lower cost per barrel storage. With the welded method, a thinner shell can be used than with riveted tanks where the seams must be caulked. As there is no leakage to cause paint deterioration, maintenance costs are also said to be cheaper.

Large Chicago Building Project Utilizes Welding

The Jefferson Electric Co., Chicago, has awarded the contract for the construction of a new $550,000 plant to The Austin Company, engineers and builders of Cleveland. The site is at the southwest corner of 25th Avenue and Madison Street in Bellwood, and comprises approximately 19 acres of property. When the plant is completed on January 15, 1932, the company will abandon its present manufacturing units at 15th and Laflin Streets and Congress and Green Streets, Chicago.

The new plant will have a frontage of 295 feet on Madison Street and 685 feet on 25th Avenue. It will be a one-story steel frame construction with a two-story office section on the 25th Avenue side, running 250 feet across and 75 feet deep. Stone facing will be used on the two street elevations. The construction will be such that additional units can be added as necessary.

Austin engineers of the Chicago office in charge of the work will employ "Elektro-Design" in the construction of the plant, a recent development of The Austin Company. The 535 tons of structural steel required for the project were fabricated and welded in the Austin shops in Cleveland. The Austin contract also includes the installation of heating and plumbing systems and a mono-rail crane of 5-ton capacity.

Badger Oxygen & Acetylene Co. Open for Business

Announcement has been received of the formation of the Badger Oxygen and Acetylene Company at 325 West Florida Street, Milwaukee, Wisconsin. The announcement states that this new organization is now in a position to furnish oxygen, acetylene and hydrogen and will soon have available a complete line of apparatus in addition to such supplies as welding rods, goggles, lighters, etc. The accompanying photograph is of the headquarters of the company. The general manager is M. B. Dunn, who has had many years of experience in the sale of gases and supplies for gas welding and cutting.

Evening Sessions Well Attended at Tennessee U.

A two-evening welding conference at the University of Tennessee, September 28 and 29, was well attended by manufacturers and shop owners in the Southern district. At the opening session of the conference, C. E. Ferris, Dean of Engineering at the University, read the address of welcome, which was followed by a paper, "Recent Developments in Welding," presented by L. C. Monroe of *The Welding Engineer*. Walter Sutton of the Crane Company presented his paper entitled "Something New in Pipe Bends," which described the new welding pipe fitting which has recently been developed by his company. The first session was closed by a lecture and demonstration on Industrial Gases, which was presented by F. J. Reuter, Chief Engineer, Southeastern Division, Compressed Industrial Gases, Chicago.

The Tuesday evening session was opened by F. C. Lowry, Director of University Extension, U. of T., who discussed the possibilities and progress of Extension Teaching in Industry. Another timely presentation by W. R. Woolrich, Professor of Mechanical Engineering, followed. Mr. Woolrich chose as his subject, "Industrial Readjustment by Education." H. W. Fetner, Southern Railroad, followed with a paper, "Welding as Applied to the Railroad." "Some Welding Problems and Their Solution" was the presentation of S. H. Jones, Welding Engineer, Burdett Oxygen Co. M. H. Hendee, representative of the General Electric Co., Atlanta, Ga., gave a description of the new WD arc welder. An American Brass Co. engineer was a demonstration of welding on copper and alloy metals, which closed the meeting.

The New Plant of the Badger Oxygen and Acetylene Company in Milwaukee. The Insert Is Mr. M. B. Dunn.

Welding Operators Make Best Guesses on Production

The Bastian-Blessing Co. reports that visitors at the National Metal Exposition which was held last month in Boston showed active interest in their display of Rego welding and cutting apparatus and accessories. The Rego booth had a live display going all the time which included a demonstration of the cutting abilities of the new Rego CC light weight full range cutting torch. Production welding of power conduit junction boxes was one of the demonstration items of most interest. These boxes are of 16 gauge mild steel to be installed in the new Boston post office now under construction. This job was done right in the booth on a regular production basis. The apparatus used consisted of a Rego SW valveless production torch, gas economizer, and a Red Star Regulator. After it was hooked up and adjusted for a neutral flame the entire unit was sealed against further adjustment. During the time it was used 347 boxes were welded, each containing 21 inches of weld or a total of 7287 inches for the week. Considerable comment was heard on the constant pressure maintained by the regulators despite the drop in tank pressure and shutting off the gas flow at the economizer between operations which totaled 908 times. The interest of this operation was increased by the contest which the Bastian-Blessing Company conducted. Visitors were invited to estimate the number of boxes which would be welded during a regular period. The one guessing closest to the correct number was rewarded with a Rego welding outfit. It is interesting to note that the winners were mostly welding operators.

The Bastian-Blessing Company Booth at the Boston Show Where Active Interest Was Maintained by a Guessing Contest

X-Ray Analysis Becomes Regular Manufacturing Operation

Hidden defects in castings, welds and electric machinery, hitherto difficult or impossible to detect visually or by ordinary methods, are now revealed by the spotlight of the X-ray in the largest laboratory of its kind in industry, recently added to the manufacturing facilities of the General Electric plant in Schenectady. This laboratory is completely equipped with a substation, rooms for taking X-ray pictures, photographic darkroom and air conditioning plant.

A 200,000-volt X-ray tube is used, the highest voltage rating commercially available, the equipment being the standard hospital deep therapy type built and installed by the General Electric X-ray Corporation. Products varying in size from very small devices to castings weighing many tons can be photographed. Two rooms are provided for this purpose. Because of the high-voltage X-rays employed, both rooms are very carefully shielded with lead lining on the roof and walls. While the X-ray photograph is being made the operator can watch the equipment through a suitably located window of lead glass.

One of the accessories in the laboratory which has been found particularly valuable is a stereoscopic viewing equipment. By taking two X-ray photographs from slightly different positions in a manner analagous to the operation of a pair of human eyes, and then placing the negatives in this equipment, an effect of depth is created. Thus the analyst can look into the casting or device and see structural details in their proper relative positions.

The laboratory has already been of great assistance to the manufacturing organization at Schenectady. A wide variety of objects has been photographed, including castings, welds, forgings, different types of raw steels, alloys, etc. In one case, a crankshaft whose design included a system of holes for lubrication was examined to determine why the lubricant was not passing freely through the holes. The point where the holes were off register was determined and the defect corrected by drilling one hole a fraction of an inch deeper.

Other recent cases include the examination of cast tool steel as part of the raw material inspection, inspection of a mercury arc rectifer assembly of rolled plate stock, study of a ball bearing assembly for a motor, the comparative tests of welds made by different processes, and other weld inspections, and the examination of a defective casting of considerable size which had been salvaged by welding, to determine whether or not the salvaging was a success.

First Fall Meeting Held by Chicago Section

The Chicago Section of the American Welding Society offered the first of its fall and winter meetings October 2 in the Palmer House. The general subject for discussion, "Building Up Worn Parts," was participated in by several engineers from the Chicago district who have made good use of hard facing materials in their manufacturing operations. Louis Perona, welding foreman, Farrel Mfg. Co., Joliet, Ill., presented the first paper in which he outlined how welded on overlays had been instrumental in prolonging the life of punching and forming dies. While he was not of the scheduled speakers, G. J. Diver, Morrison Railway Supply Corp., Chicago, presented an interesting discussion on hard facing problems in the railway field. He was followed by J. E. McCauley of Sauerman Bros., manufacturers of excavator shovels, who presented some interesting figures on the cost angles of this type of work.

The meeting was preceded by the get-together dinner which has been so popular with the welding fraternity in Chicago. The dinner is served at 6:00 o'clock and offers an opportunity for members and friends to get acquainted before the meeting starts. The next meeting of the Section will be held in the Palmer House on Friday, November 6. The meeting starts at seven. Everyone who is within traveling distance of Chicago has a cordial invitation to be there.

W. D. Patterson Fatally Injured in Glider Accident

The many friends of William D. Patterson, president and treasurer of the American School of Welding, St. Louis, Mo., will regret to learn of his death in a glider accident on the afternoon of September 13. Mr. Patterson, a glider enthusiast and president of the St. Louis Glider Club, was being towed on an inclined runway when a cross wind elevated one wing of his glider so that it was thrown out of control. The towing automobile apparently was unaware of the mishap and did not stop until after the machine had risen to an altitude of 30 feet and nose dived. Mr. Patterson was thrown out head first and died fifteen minutes later.

In addition to his activities in the glider field, Mr. Patterson was very ac-

ive in the affairs of the St. Louis Welding Society of which he was the vice-president at the time of his death. He founded the welding school of which he was the head several years ago and had come to be recognized as an authority in welding.

Surviving him are his widow, a four-year-old son and a brother, J. Edgar Patterson who was associated with him in the American School of Welding and the vice-president of the organization.

Pressed Steel Tank Advances Herman Merker

Herman Merker, Secretary of Pressed Steel Tank Company, Milwaukee, has recently been placed in charge of Market Research and Development for this company.

In the past, Mr. Merker has been responsible for a number of new markets for the products of the Pressed Steel

Herman Merker

Tank Company; and his work has also resulted in the development of a number of new products. It is expected, therefore, that these additional duties will result in the uncovering of further new users. The Pressed Steel Tank Company's line consists of: Seamless Steel Barrels, Drums, Tanks, Cylinders and Special Shapes; also Welded Steel Barrels and Drums.

Mr. Merker, who until recently was both secretary and sales manager, has turned over the work of sales manager to Mr. P. T. Babcock, and will devote his entire time to secretarial and research duties.

Flash Welding Equipment for Pipe Installed in Etna Plant

Spang, Chalfant & Company, Inc., manufacturers of welded pipe report the recent installation of new electric flash welding equipment in their Etna (Pa.) plant. This process of welding, it is stated, increases the facilities for manufacturing double length pipe in all sizes and gauges from two-inch to twenty-inch O. D. pipe, and up to 55 feet maximum lengths. Also this method will make possible greater economies in shipping and installation costs in the field. The flash butt-welding of the pipe is effected mechanically in a large specially built machine, a process which will materially speed up production in this industry.

The heavy electric current which is required to complete the fusion of the metal is applied through heavy copper connected jaws or bands which clamp each joint of pipe adjacent to the ends where the weld is to be made. The joints of pipe are then brought together mechanically, with the current on, which forms the arc which heats the ends of the pipe to a uniform welding temperature, completing the fusion of the ends.

The current is then cut off and heavy pressure instantly applied, compressing the joint and forcing out practically all of the plastic material including slag and oxides, and leaving the joint of the parent metal so closely knit that it is in.possible of detection. During the process of welding, the grain structure of material is refined, and tests are said to prove that pipe welded in this manner is stronger at the point of the weld than the adjacent parent metal.

A special trimming machine removes the rough edges of the flash from the joint, both inside and outside, after which the double-length pipe is tested hydrostatically under maximum pressure.

Under-Water Cutting Demonstrated at Wisconsin Conference

A three day conference on the subject of welding was held at the University of Wisconsin on October 8 to 10, under the auspices of the Departments of Mechanical Engineering, the College of Engineering and the University Extension Division. This is the second welding conference which has been sponsored by the University at Madison. The first day's program of papers was devoted to a general review of the position which the welding processes occupy in industry and a series of papers on the fundamental sciences which form the basis for the practical application of all of these processes. The papers presented on the following two days were more directly concerned with the practical and working aspects of these processes.

The following is a list of the papers presented and the authors:

Greetings from the College of Engineering,

Dean F. E. Turneaure.

The Present Status and the Future of the Science and Art of Welding,

H. S. Card, Editor, *The Welding Engineer.*

Some Elementary Electrical Principles as Applied to Welding,

L. E. A. Kelso, Department of Electrical Engineering, University of Wisconsin.

Some Metallurgical Properties of Metals and Their Influence on Welding,

Dr. J. F. Oesterle, Department of Mining and Metallurgy, University of Wisconsin.

Some Theoretical Aspects of Gas Flame Welding,

O. L. Kowalke, Professor of Chemical Engineering, University of Wisconsin.

Some Theoretical Aspects of Welding with Electricity,

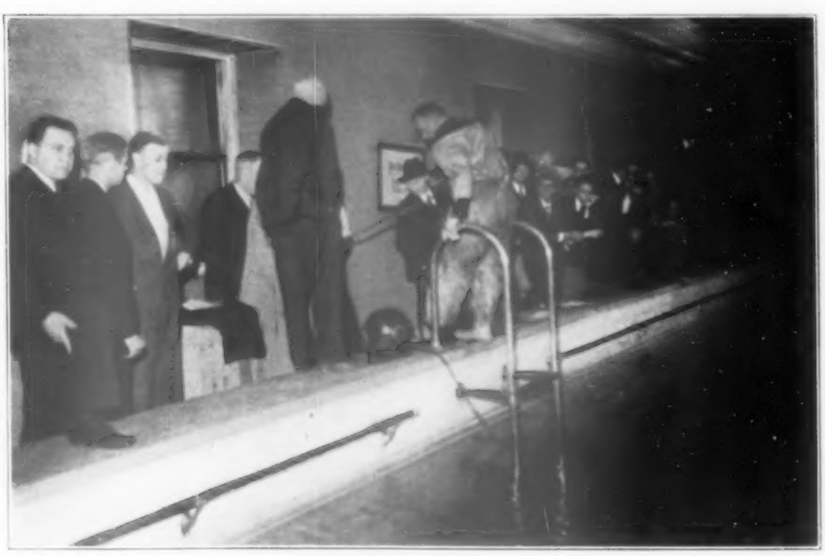
K. L. Hansen, The K. L. Hansen Engineering Co., Milwaukee, Wis.

Some Economic Trends in Today's World,

Selig Perlman, Professor of Economics, University of Wisconsin.

The X-Ray Method of Inspection,

Claude Gordon, The Gordon Laboratories, Chicago, Ill.



Diver Preparing for Under-Water Cutting Demonstration at Wisconsin Welding Conference.

The Stethoscopic Method of Inspection,
Linde Air Products Co.
The Substitution of Welded Plates and Shapes for Castings,
Otto C. Voss, Superintendent of Welding and Tank Shops, Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Lindewelding—a New Technique of Pipe Welding,
Fred Outcalt, Linde Air Products Co.
The Welding of Bronze and Copper by the Electric Arc Method,
W. C. Swift, American Brass Co.
Demonstration and Discussion of Hard Surfacing,
E. F. Smith, Haynes Stellite Co.
Demonstration on "Liquid Air" and Illustrated Lecture on "The Manufacture of Oxygen,"
G. E. Harcke, Research Engineer, Air Reduction Sales Co.
Demonstration of Under-Water Cutting,
To be presented by Under-Water Metal Cutting Corporation, New York City.
Application of Modern Oxy-Acetylene Welding Methods in Pipe Line Construction,
W. R. Ost, Air Reduction Sales Co.
The Use of Welding in the Fields of Plumbing and Heating,
Fred Outcalt, Linde Air Products Co.

In a large room adjoining the lecture hall, a series of excellent exhibits of welding equipment and materials and of welded products was arranged by the following firms:

Air Reduction Sales Company.
American Brass Company.
American Optical Company.
Badger Oxygen and Acetylene Company.
Electric Welder Corporation.
General Electric Company.
Hall Steel Joist Company.
Hobart Brothers Company.
Imperial Brass Manufacturing Company.
Lincoln Electric Company.
Linde Air Products Company.
National Electric Arc Welder Company.
Northwestern Manufacturing Company.
Sight Feed Sales Company.
Torchweld Equipment Company.
Welding Engineering Company.
Westinghouse Electric Company.
Wisconsin Oxygen-Hydrogen Company.

Those members of the faculty, who were in charge of the conference, had evidently attempted to outline a program which would maintain interst at a high peak, and it was the general verdict of those who attended that they were successful in this attempt. Prof. J. M. Dorrans was in general charge and Prof. B. G. Elliott presided at the lecture sessions.

A particularly novel and interesting feature of the conference was a demonstration of cutting metal under water, which was staged in the swimming pool of Lathrop Hall. Mr. L. S. Haggland, manager of the Under-Water Cutting Corporation of New York City, first explained how submarine salvage work was handicapped for many years by the lack of efficient cutting processes, being limited to the use of the chisel or explosives. With the advent of the flame cutting torches there were developed several models with special attachments to make possible the use of the flame cutting process under water at considerable depths. The process demonstrated makes use of a carbon arc to generate the necessary high temperature and the carbon electrode used has a small hole running through its longitudinal access through which oxygen is passed and directed to the point of operation.

The conditions surrounding this demonstration were very nearly perfect as compared to the handicaps which the deep sea diver encounters in his work, but this serves to emphasize the skill and courage which is required of the men who follow this specialty. Mr. Haggland donned a typical diving uniform and was furnished with an air supply from a hand operated pump. The current for operating the cutting torch was supplied by two Lincoln Arc Welders hooked up in parallel, so as to obtain a net current of approximately 600 amps. at a terminal voltage of 30 volts. During the demonstration several kinds of metal were cut and the time was noted as follows:

A—Tool Steel, 1½ in. in diameter; line of cut, 30 degrees to the longitudinal axis of the bar; cutting time, 2 min. 10 sec.
B—Phosphorous Bronze, ⅝ in. in diameter; cutting time, 70 sec.
C—Cast Iron Angle, 1½x1½x¾ in.; cutting time, 1 min. 33 sec.
D—Brass Angle, ¾x1x⅛ in.; cutting time, 5 sec.

Many of the visitors at the conference remained to witness a rainy day football game which developed a 7-7 score.

General Electric Offers Plan of Employment Assurance

Affirming its confidence in the future of the electrical industry, the General Electric Company, through President Gerard Swope, has offered its shop employes a plan which would virtually guarantee them six months employment beginning November 1. The new proposal, which is called "a plan to prevent further layoffs for lack of work," is to be voted on by employes of the company who are members of the General Electric unemployment pension plan, which embraces the great majority of all shop employes of the company.

The plan, as described by President Swope, is "to so divide the work that there will be no further layoffs for lack of work between November 1, 1931, and April 30, 1932, without compensation; and that all those on the payroll November 1, 1931, will receive during this period not less than the equivalent of one-half of their average weekly earnings for full time, but in no case more than an average of $15 a week. If actual earnings are above that average, however, the employe is to receive his actual earnings."

The method of insuring this result is to be three-fold. Employes are to be assigned work outside their regular work, if necessary, at the prevailing rates of pay for such work. The unemployment emergency fund, which has been operating since December 1, 1930, is to be augmented by increasing the contributions of one per cent of earnings now being made by all employes who are working more than half time to two per cent, the company increasing its own contribution to match these of the men. Finally, if these two methods are inadequate, the board of directors of the company will be asked to authorize additional payments by the company to the unemployment emergency fund without increasing the employes' contributions to the fund.

The American Brass Co. Exhibit at American Gas Assn.

The American Brass Company exhibit occupied Booth 805 at the thirteenth annual convention of The American Gas Association, held October 12 to 16, in the Public Auditorium, Atlantic City, N. J.

The feature of this exhibit was a display of welded tanks, fabricated from Everdur Metal. Two tanks were shown, one all-welded, and the other constructed of a seamless shell with an apron welded on the bottom. Everdur Metal combines the strength and fabricating properties of steel with the corrosion resistance of copper. It is readily weldable by all standard gas and electric methods.

In addition to the Everdur tanks, a Brown and Brothers Seamless Drawn Copper Range Boiler was exhibited, which has recently been improved in design.

Other items exhibited were Anaconda "85" Red-Brass Pipe for hot water system connections, and Anaconda Deoxidized Copper Tubes for service lines and connections for gas appliances. W. Harold Dowd, exhibit manager, was in charge, assisted by Clinton E. Swift, welding engineer.

St. Louis Welding Society Elects Officers

At a meeting held September 25, 1931, the St. Louis Welding Society elected officers for the coming year as follows:

E. P. Barnes, President.
R. G. Ellis, Vice-President.
W. A. Tolkacz, Secretary-Treasurer.

Directors: W. Britt, N. F. Moss, A. V. Faucek, E. Schmidt, R. Hartnett, and B. N. Osmin.

The society is growing rapidly and many educational meetings will be scheduled for this year. Sixty-two members have enrolled for the course in "Metallurgy of Welding" to be given at the Hadley Vocational School under Capt. E. H. Sager of Washington University and E. C. Meinholtz of the Missouri Pacific Railroad.

The Roeblings: A Book Review

The world is familiar with the Roebling name. Wherever it is mentioned it calls to mind achievements in bridge-building, engineering and accomplishments in industrial activity. Hamilton Schuyler presents an intimate account of the lives of the Roeblings—father, sons and grandsons—their lives and personalities. The author is not mainly concerned with the material evidences of Roebling achievement, but rather he has attempted to reveal what manner of men they are that has enabled them to achieve such continuing success. Technical descriptions have not been included in elaborate detail, yet the technically minded will find concise data which will be of interest to them and yet understandable to the general reader. The three sections of the book deal in order with John A. Roebling, father; Washington A. Roebling, the son, and finally the lives of Ferdinand William Roebling and Charles Gustavus Roebling.

The publishers are the Princeton University Press, Princeton, N. J. The price of the book is $5.00 per copy.

Welded Rolled Steel Construction Shown in Bethlehem Leaflet

A four-page illustrated folder is being distributed by the Bethlehem Steel Company, Bethlehem, Pa., which describes the welded-construction service which this company is now rendering its customers. It is pointed out that the highly competitive condition in the machinery and equipment market has awakened interest in welded construction. Units can be made up from blue prints, eliminating the need for patterns and other items of expense and delay. These units, it is pointed out, can be operated with greater precision and they have a high degree of fatigue resistance. The Bethlehem organization is prepared to consult with manufacturers in the redesign of their products and make recommendations to secure the best results from this method of fabrication. Among the welded items illustrated there are huge gear guards, machine bases, gears and pulleys and tanks.

"Welded Steel Gears" New Lukenweld Booklet

Lukenweld, Inc., Coatesville, Pa., a division of Lukens Steel Company, is distributing an 8-page illustrated booklet with the above title which describes the manufacture of Lukenweld welded steel gear blanks and their properties. The descriptive material which is prepared by Everett Chapman, director of Engineering and Research for the Lukenweld Company, gives a step by step picture of gear blank manufacture. In making the rim, for which .40 carbon steel is used, the material is flame cut to exact dimensions, the ends scarfed for welding and then rolled to form a circle after which it is welded. A novel method of keeping the entire rim section of the same analysis is used. The scarf is cut to a point somewhat above the tooth root. The weld is then made from this point to the inside of the rim. The remaining open space is used for indexing the teeth so that no weld metal of lower carbon content appears on the surface of a tooth. It is also pointed out how the exact weight of the web, spokes and hub are derived using the least possible material and yet obtain the necessary strength. Gear manufacturers are shown how they can more economically use Lukenweld blanks and eliminate all losses from scrapping partially cut gears which are found to have blow holes, minimize wear on expensive cutting tools, strike out pattern storage cost and speed up deliveries.

Armco Bulletin on Pipe Coatings

American Rolling Mill Company of Middletown, Ohio, who have gone into the manufacture of spiral welded pipe on a large scale, have also done some extensive development work on coatings for different pipe. A bulletin has just been issued which describes six different coatings, each of which is applied with due consideration for the corrosive conditions which the coating must encounter in actual service. The information is supplied in the form of an eight-page bulletin printed in two colors.

New Lincoln Bulletins on Structural Design

Among the recent publications of the Lincoln Electric Company are two useful bulletins containing design information for welded construction. One of these is Application Sheet No. 23, Series 2, with information and illustrations on the subject of the design of bases. The other is Plan No. 27 on the Series on Structural Arc Welding and is devoted to the subject of Arc Welded Mill Building with special reference to the construction of bar frames.

Arcos Bulletin Describes Line of Electrodes

Arcos, Inc., 401 N. Broad St., Philadelphia, Pa., is circulating a four-page bulletin which describes the line of electrodes of their manufacture for various requirements. Among those noted particularly is Chromend for welding the 18-8 chrome-nickel alloys. This rod is said to produce a deposit of the same analysis as the parent metal with the same physical properties and is especially suitable for work that must be corrosion resistant. In the hard surfacing field there are two electrodes described, one of high manganese content for switch frogs and similar uses and another for abrasive wear. Other electrodes in the line include those for use on aluminum and aluminum-silicon alloys, cast iron, speed welding on steel, a high tensile and ductility rod and a general purpose electrode.

New La Roc Electrode Holder Described in Folder

The La Roc Sales Company, 1550 East 63rd Street, Chicago, is distributing a folder to the trade which describes the many desirable characteristics of the new La Roc electrode holder which has recently been put on the market. This holder which is 13 inches over all and weighs one pound eight oz. has a spring type friction grip in which the electrode can be inserted at any angle. It is also indicated that the large handle and thick fibre shield keeps the holder cool even under constant operation. The cable is clamped firmly in place with a set screw and all solder eliminated. The grip, of hard drawn copper, can be quickly changed if necessary simply by loosening one nut and inserting a new grip.

Conveyor Used in Connection with Spot Welding

The Mathews Conveyor Company, Cleveland, Ohio, having developed a special conveyor for the purpose of speeding up sheet metal operations in its own shop, is making arrangements to market equipment of this sort to other manufacturers for use in connection with production welding. The unit is made up of adjustable metal supports

Roller Conveyor Used in Connection with Spot Welding Operations.

on which is placed a section of roller conveyor. The roller conveyor is mounted on ball bearing wheels which run in channels on top of the supports. The steel or other metal to be welded is placed on the roller and can then be easily moved in a horizontal plane back and forth underneath an automatic arc welding head or under the contacts of a spot welder as well as to the right or left on the roller conveyor bed. Although no actual cost or time figures have been computed, Mathews officials report that this unit has brought exceptional speed and economy into the company's welding department.

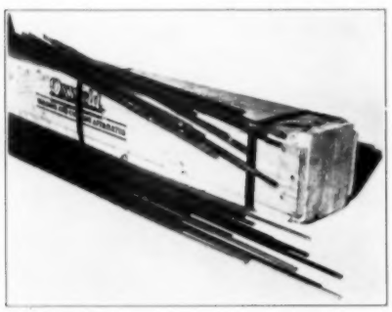
All Oxweld Welding Rods Shipped With Standardized Markings

The Linde Air Products Company, 30 East 42nd Street, New York, N. Y., has

announced a new standardized set of markings on all Oxweld welding rods. With three exceptions, all rods ⅛-inch in diameter and larger are stamped with the name "Oxweld" as well as the number and type of rod. On the smaller sizes of welding rod where it is not possible to stamp the name, the boxes in which the rod is shipped are plainly marked "Oxweld" with the number and type.

Oxweld No. 1 High Test Patented Steel Rod is marked "Oxweld No. 1 H. T. Patented."

Oxweld No. 2 High Carbon Steel Rod is marked "Oxweld No. 2 Steel," while Oxweld No. 3 Nickel Steel Rod bears the marking, "Oxweld No. 3 Steel." For manganese steel welding there is the Oxweld No. 4 Manganese Steel Rod. The ends of each rod are painted green for identification. Copper-coated Oxweld No. 7 Drawn Iron Rods are marked "Oxweld No. 7." Oxweld No. 9 Cast Iron Alloy Rods are marked "Oxweld C. I."



A Typical Oxweld Shipping Container.

There are nine different non-ferrous welding rods. For high strength welds in copper, brass or bronze, or for bronze-welding malleable iron, steel or cast iron, there are the non-fuming Oxweld No. 21 H. S. (High Strength) Patented Bronze Rods, which are marked "Oxweld No. 21 H. S. Bronze Patented."

For bronze-welding cast iron and for welding brass, bronze, etc., there are also the Oxweld No. 10 Bronze Rods, which are marked "Oxweld No. 10 Bronze"; and Oxweld No. 11 Drawn Manganese Bronze Rod, stamped "Oxweld Manganese Bronze." Oxweld No. 13 Drawn Brass Rods, used on sheet or cast brass, are all stamped "Oxweld Brass." For rail bonding and metal furniture manufacture there is the Oxweld No. 19 Cupro Rod, which is marked "Oxweld Cupro."

There are three different types of aluminum welding rods. For sheet aluminum work there is the Oxweld No. 14 Drawn Aluminum Rod. These are not marked. The box, however, is stamped "Oxweld." For aluminum castings there is the Oxweld No. 15 Lynite Aluminum Rod, marked "Oxweld Lynite." And for cast and sheet aluminum and aluminum alloys there is the Oxweld No. 23 Aluminum Rod, which is labeled "Oxweld No. 23 Aluminum."

Superior Steel Announces Su Veneer with Rustless Surface

The Superior Steel Corp., Pittsburgh, has recently placed on the market a new product known as Su Veneer, in which ordinary open-hearth steel is combined with rust-resisting metal. It is offered as a material which is more enduring than chromium plated steel and materially cheaper than solid stainless steel. More than 2,000 etch tests on this new metal for which process patents have been applied, have failed to show up a single imperfect weld.

This development will in all probability increase the range of use of stainless metal, since heretofore manufacturers have had only the choice of chromium plated steels or straight stainless. It is being offered by the makers running from 80 to 90 per cent open-hearth steel and 10 to 20 per cent rust resisting material on either one or both sides. Widths range from ½ in. to 22 in.

"Elkaloy" Spot and Seam Welding Electrodes

P. R. Mallory & Co., 3029 E. Washington St., Indianapolis, Ind., have developed a new electrode material for low-speed and foot-operated resistance welding machines known as "Elkaloy." This new material is a copper-base alloy of moderate price, which is offered as a substitute for copper on the basis of longer production life. It is claimed that this material has five times the life of copper on spot welding machines particularly the hand operated type. It also is adapted to seam welding on terne plate of galvanized steel since it does not pick up scale and coating to any appreciable extent, which is an item of expense eliminated in fewer redressings.

Several grades are available, hardness ranging from 60 to more than 100 on the Rockwell B scale or 300 Brinell. With increased hardness there is a drop in conductivity, but the range is such that "Elkaloy" can still be substituted without changes in the electrical elements of the welding machines. At the temperatures of the average water-cooled electrode, the material does not anneal and hence does not readily mushroom out.

Hercules Motors Making Small Series of Fours

The Hercules Motors Corporation of Canton, Ohio, is now manufacturing a line of small, modern Four-Cylinder Engines and Power Units designated as the Hercules IX Series. Models are available in the following bore, stroke and displacement.

Model	Size	Displacement
IXA	3 "x4"	113.1 cu. in.
IXB	3¼"x4"	132.7 cu. in.

The IX Series Engines and Power Units embody the usual Hercules fundamental characteristics and simplicity of design and construction. They are designed and built for heavy-duty purposes and are arranged to accommodate all modern accessories.

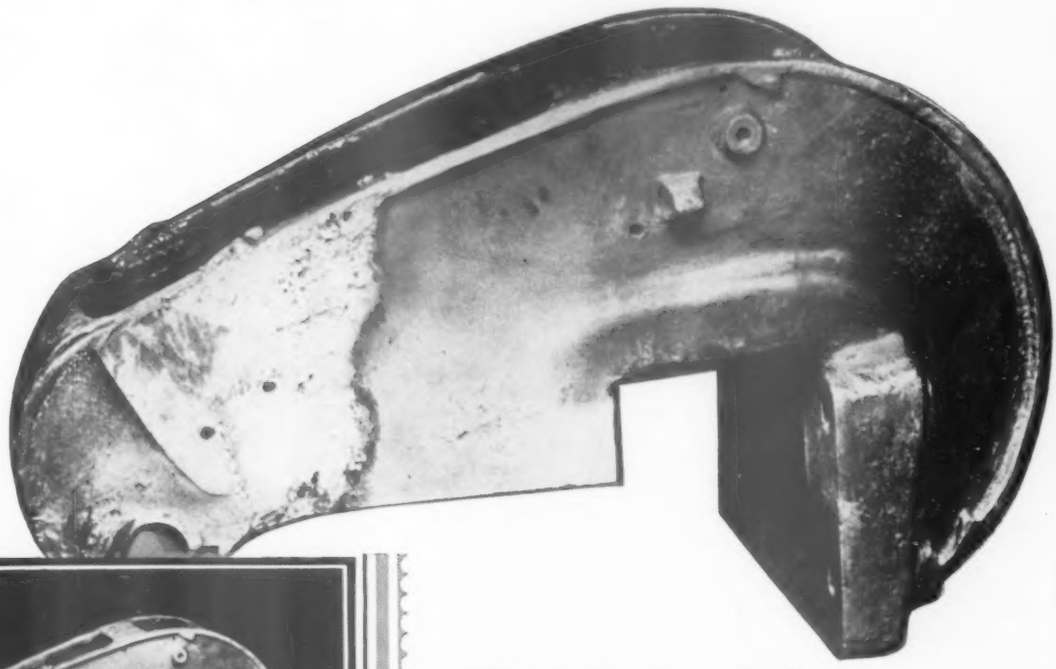
Announce New Hand-Drive Mechanical Cutting Torch

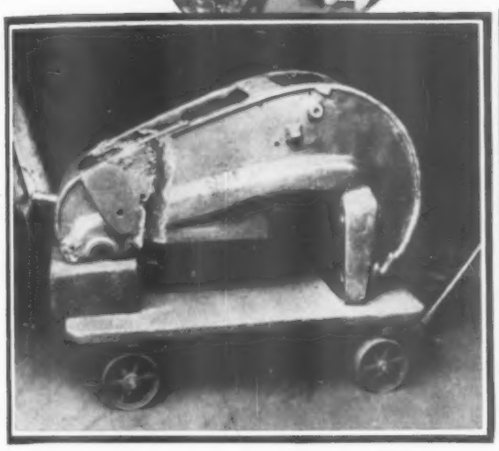
F. F. Backstrom & Son, 4646 West 12th Place, Chicago, Ill., have recently placed on the market a new hand-driven mechanical cutting torch designated "Flame Cutter." They recommend this new unit for roughing out cuts on all flat steel shapes. It is of the radial drill type of construction with 15 inch travel on the main arm and a cross arm travel of 8 inches. It is pointed out by the manufacturers that the gear drive will derive smooth accurate cuts. The "Flame Cutter" can be furnished with any of the standard machine cutting torches that the buyer desires or without. The Model SM-1 can cut circles of 16 inches maximum. Other machines can be supplied to meet any specific requirement.

New Electrode Holder Announced by Northwestern

The Northwestern Manufacturing Co., Milwaukee, Wis., has just announced the addition of a new electrode holder to their line of electric arc welders, electrodes and accessories. This new holder is 11¾ in. over all and weighs one pound 3 oz. The handle is of round polished red fibre 1⅝-in. outside diameter. Good ventilation is provided for a cool comfortable grip. The lower jaw is described as a pure copper strip, ¾ by ⅛-in. which runs the length of the holder and is reinforced with a thin strip of steel brazed on for current carrying capacity, rigidity, strength and minimum weight. The gripping surfaces are free from corrugations the manufacturers point out which gives good contact and grip on the rod. Cable runs through the handle and all connections are insulated from the spring so that there can be no accidental shorting. This holder will handle any electrode up to and including 5-16-in. diameter.

The New Arc Welding Electrode Holder Which Is Being Marketed by the Northwestern Manufacturing Co.





Iron casting ready for welding with Tobin Bronze. The repair was completed in 3¼ hours.

ANACONDA
from mine to consumer

There is a suitable Anaconda Filler Rod for every bronze-welding purpose. Principal Anaconda Welding Rods, with their melting points, are listed below:

for oxy-acetylene welding

Tobin Bronze*	1625° F
Manganese Bronze	1598° F
Brazing Metal	1634° F
Naval Bronze	1625° F
Electrolytic Copper	1981° F
Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F

for arc welding

Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F

*Reg. U. S. Pat. Off.

Welded with TOBIN BRONZE *in 3¼ hours* without preheating

When this heavy cast-iron press frame cracked—in a place once welded with a ferrous rod—no time was taken in preheating it. Using Tobin Bronze rods welding was started *at once*...for Tobin Bronze flows at so low a temperature that preheating is seldom required. In 3¼ hours the repair was complete.

The speed that Tobin Bronze makes possible is a big factor. It reduces the time-cost of welding and returns broken machinery into service quickly. Tobin Bronze welds are sound and homogeneous...usually make fractured cast-iron parts as good as new.

Publication B-13 contains full data about Tobin Bronze and other Anaconda Welding Rods. A copy will be sent on request.

THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Connecticut
Agencies and Sales Offices in Principal Cities

ANACONDA WELDING RODS

Lincoln Electric Announces Improved "Fleetweld"

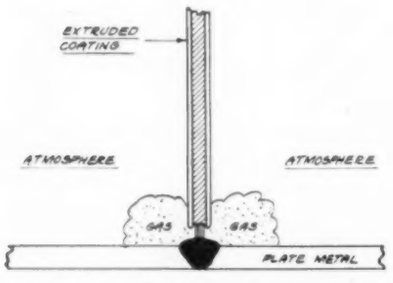
The Lincoln Electric Co. of Cleveland announces the introduction of an improved, heavily coated electrode for welding within the shielded arc on mild steel. Like its predecessor this electrode will be known commercially as "Fleetweld."

Claims for the new electrode, as compared with the old, are a higher ductility of weld metal, 20 to 30 per cent elongation in two inches; tensile strength of coupons to average between 65,000 and 80,000 lbs. per sq. in., and resistance to corrosion, greater than mild steel. There is little "spattering" with the new electrode.

Ductility Test Made on a "Fleetweld" Test Specimen.

The shielded arc process, eliminating oxides and nitrides, gives improved ductility, tensile strength and resistance to corrosion; porosity is avoided and the layer of easily removable slag, the residue of the burning coating, forms a protection for the hot metal while cooling.

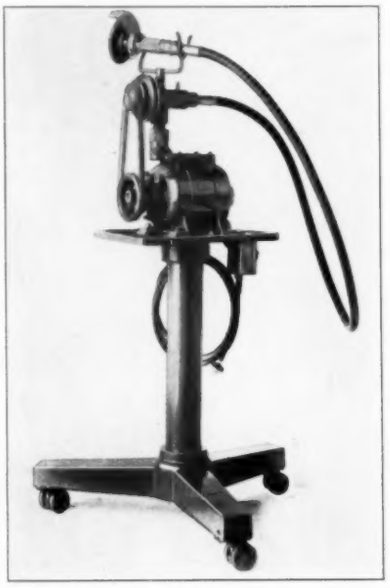
The new Fleetweld requires high welding current and increased welding speed is claimed. Fleetweld was first introduced, after much research, in 1929. The heavy coating of the new rod is of special composition material, the metal core is drawn to rigid specifications and carefully selected and tested. It will be produced in diameters from ⅛" to ⅜" and in two lengths, the standard 14-inch, and the special 18-inch, packed in square metal protective containers.



This Diagram of the Shielded Arc Shows How Harmful Elements Are Kept Out of the Weld.

New Flexible Shaft Machine Announced by McNeil Bros.

The McNeil Bros. Co., Cincinnati, Ohio, have recently placed on the market a new all-purpose flexible shaft machine which in one unit will serve a wide range of uses. The ordinary uses of a flexible shaft unit such as grinding, wire brushing, buffing and polishing, can be augmented by means of a special high speed attachment which provides six speeds ranging from 865 to 10,500 R.P.M. With this attachment other operations such as form filling, grinding and rasping are added to its uses.



The New McNeil Model M Flexible Shaft Grinder.

An 8-page illustrated folder describes two units of the Model M series. Model M-2 is driven by a ½ H. P. motor and has a capacity as follows: 6x¾-in. grinding wheel, 6x1-in. wire brush, 9-in. sanding brush and up to ⅜-in. drill. The M-4 machine has a 1 H. P. motor and will take an 8x1-in. grinding wheel, 7x1-in. wire brush, 9-in. sanding disk and a drill up to ⅝-in. All models are equipped with ball and roller bearings at strategic points. Mounting is developed with an eye to convenience and safety. In addition to the details covering the machines, the booklet contains lists of all accessories to be used with them.

News of the Industry

L. J. Peters, of San Diego, California, is opening a new welding shop at 1404 "F" Street under the name of The Peters Welding Shop. New Equipment is being installed which includes a new Shrader Electric welder (Ford truck mounted type). General welding of all kinds will be featured in the new shop. Mr. Peters was formerly connected with the Kelly Welding Works, and is well known in San Diego, having been connected with the welding industry in that vicinity for over twelve years.

W. H. Bleecker, Jr., has been appointed sales manager of the Page Steel & Wire Co., with headquarters at 701 American Bank Building, Pittsburgh, Pa. C. N. Johns was appointed general manager of the company, with headquarters at Monessen, Pa.

Negotiations were recently completed whereby F. M. Jackson took over the plant of the United Tank & Steel Products Co., Ltd., of Los Angeles, Calif. The new concern will operate under the name of the United Tank & Welding Works, with Mr. Jackson as manager and Chas. T. Watkins, formerly associated with the old company, will be plant foreman. The change of ownership was effective Sept. 1. Mr. Jackson was formerly associated with the Chain Belt Company. General welding and machine work of all kinds as featured heretofore in the plant will be carried on by the new owners. 24-hour service will also be maintained.

The Porter Welding Shop in Bell, Calif., has been moved to a better nearby location, and the building enlarged to afford added convenience and better working facilities. M. Porter, owner of the shop, has been in the welding business in this district for about ten years. General welding of all kinds, together with blacksmithing, is featured in the shop.

The Electric Steel & Mfg. Co., of Huntington Park, Calif., recently added a new 600-amp. motor driven Lincoln electric welder to their welding department. J. A. Cowan is in charge of the welding for this company, which features stainless steel and alloy steel castings.

F. J. Nelson, of 6239 Gifford, in Bell, Calif., recently purchased the equipment of the Kaufman Welding Works, who until a short time ago operated the shop at this location. Mr. Nelson will continue the business at this location, operating under the name of the Nelson Welding Works. General welding of all kinds will be featured.

Major E. L. Lorehn, vice-president and general manager of the Cameron Welding & Iron Works, at Houston, Tex., is on duty with the Texas National Guard in the East Texas oil fields which are under martial law pending settlement of the over-production situation in that field. Major Lorehn is in command of the 124th Cavalry.

The American Manganese Steel Company announces the appointment of W. C. Bruton as sales manager for the Pacific Northwest territory, which includes Oregon, Washington, Idaho, and British Columbia. Mr. Bruton was for a number of years sales engineer for this company out of the Oakland, Calif., office.

The Winslow Government Standard Scale Company of Terre Haute, Indiana, is now using arc welding in the production of a large line of weighing scales, utilizing steel plate and structural shapes and effecting weight savings up to 40%.

The welding of lead and its alloys is the subject of an illustrated lecture scheduled for a meeting of the Institute of Welding Engineers, London, to be held October 15. The lecture will be prepared by Mr. E. B. Partington.

The Alumaweld Distributing Company of Iowa has established state headquarters at 501 First Avenue, So., Ft. Dodge, Iowa. Mr. M. J. Bailey is State Agent for the firm and L. R. Ellogly is associated with him. The staff will include 25 field representatives and a service shop has been established for welding aluminum products.

R. C. Todd has been appointed assistant vice-president of the American Rolling Mill Company. Mr. Todd was formerly assistant general sales manager. His new duties will involve special duties in connection with the company's sales activities.

Allen Renton, proprietor of the Hawaiian Gas Products Company, Honolulu, has been on a business trip to the United States and was a visitor in Chicago September 15 and 16.

A splendid review of some of the problems involved in the application of welding to steel structures was included in an address delivered at a conference of the New York State Building Inspection Officials at Yonkers, N. Y., September 29, by Lee H. Miller, Chief Engineer of the American Institute of Steel Construction.

A description of tie-treating retort fabricated by arc welding for the C. B. & O. Railroad and of rotary kilns fabricated by oxy-acetylene welding are included in a committee report prepared for the Twenty-Second Conference of the Master Boiler Makers Association to be held in Chicago in 1932.

In a recent issue of the Oil and Gas Journal, J. W. Haygood, Service Supervisor of the Linde Air Products Company, tells how procedure in laying pipe lines across a river was improved by laying two parallel lines across the river simultaneously instead of laying a single line in one operation and repeating the procedure to lay the second line.

Some idea of the volume of welding which may be required in a large manufacturing plant can be gained from an article by J. R. Weaver of the Westinghouse Electric & Manufacturing Company in the October issue of Machinery which speaks of the fabrication of 400 welded jigs per month.

The Croll Reynolds Egineering Company of New York is making expansion joints up to 30 inches in diameter with a liner of Monel metal welded to the forged steel flange on one end; the purpose of this welded-in liner being to protect the expansion joint against corrosion.

Harry L. Erlicher, who entered the employ of the General Electric Company as an office boy in the purchasing department, has been appointed purchasing agent, succeeding L. G. Barker, who retired on October 1 after completing 43 years' continuous service with the company.

The Lincoln Electric Company has taken over their Los Angeles agency from the A. H. Pier Company, former distributors in that territory, and will continue business at the same location (812 S. Mateo St.) under the management of S. H. Taylor, Jr., who for several months has had charge of the Pacific Coast Distribution for the Lincoln Company. A full line of all types and models in electric welding units together with a full stock of welding accessories will be carried.

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C. G. M. A. Luncheon This Month

The Compressed Gas Manufacturers' Association have arranged a luncheon meeting at the Princeton Club, 39th Street and Park Avenue, New York City, at 12:30 P. M. Thursday, October 22. The speaker will be F. J. H. Cracke, United States Appraiser of Merchandise, Port of New York. All members of the Association have been urged by the Secretary to attend and to bring guests to enjoy what promises to be an exceedingly interesting talk.

A bulletin recently issued by the Thomson-Gibb Electric Welding Company of Lynn, Mass., and Bay City, Mich., illustrates a projection welder which will deliver pressures up to one thousand pounds and which was made for welding large wire automobile wheel hub shells.

Classified Ads

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Other Ads—$1.00 per line, minimum 4 lines.
Count 8 words to line. Add 6 words for keyed address.

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45 New General Electric WD 400 amp. MG sets, any type motor. Price.....$600.00 each
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We are desirous of securing the services of a Sales Engineer to take complete charge of the distribution of welding wire throughout this country and Canada. Will you kindly write us, giving in full your qualifications for a positon of this kind. Address Box 438, The Welding Engineer.

POSITIONS WANTED

Combination Welder—15 years' experience in all classes of job shop and production work; 6 years' experience in automotive and construction machinery repair. Some experience in tool die and jig making and blacksmithing. Some sales experience. Desire connection with some reliable concern. Highest recommendations. C. W. Myers, 1330 Scribner Ave., Grand Rapids, Mich.

Welder-Blacksmith—Electric arc, oxy-acetylene and some atomic hydrogen experience in machine shop, job shop and construction welding. Thirty-four years old, married, willing to travel. Graduate of Lincoln Electric Co. school. L. R. Knapp, 210 E. 10th St., Junction City, Kan.

Position Wanted—As foreman, layer out or erector. Have 20 years' experience. Best of references. Can get production at low cost. Will go anywhere. Can estimate work and labor. Address Box 439, The Welding Engineer.

Combination Welder—Have 4 years' experience on maintenance welding by both gas and arc processes. Good references. Married. Will go anywhere. J. H. Jarvis, 678 S. Main St., Dayton, Ohio.

Electric Arc Welder—With 12 years' experience desires permanent job with reliable industry on production or maintenance work. Steady, reliable worker. H. Furman, 102 Fowler St., Port Jervis, N. Y.

Welding Superintendent—Ten years' experience in sheet metal fabrication, including design and layout for welding. Familiar with application of gas, arc and spot welding to this type of work. Have had full charge of large sheet metal shop and can produce satisfactory results from every angle. Exceptional references. Address Box 440, The Welding Engineer.

Capable Combination Welder desires connection. Address Ernie Woodlief, Box 317, Newaygo, Mich.

Welding Equipment Sales Engineer—With several years' practical experience in establishing and working with jobbers from Coast to Coast, would like to line up with manufacturer of high grade Gas or Electric Welding Apparatus or accessories on salary and commission basis. I am at present unemployed, but can furnish best of references from my former employers. Wire or write Box 441, The Welding Engineer.

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